# DEEP-SEA SOUNDINGS

IN THE

# NORTH PACIFIC OCEAN

U. S. HYDROGRAPHIC OFFICE.

No. 51.

# DEEP-SEA SOUNDINGS

IN THE

# NORTH PACIFIC OCEAN,

OBTAINED IN THE

## UNITED STATES STEAMER TUSCARORA,

COMMANDER GEORGE E. BELKNAP.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1874.

# DEEP-SEA SOUNDINGS IN THE NORTH PACIFIC OCEAN.

## OBJECT OF THE CRUISE, AND THE ROUTES EXAMINED.

In the Spring of 1873, the United States steamer Tuscarora, Commander George E. Belknap, was detailed for the purpose of finding a practicable route for a submarine cable between the United States and Japan.

Nothing more was contemplated than an examination of the bed of the ocean to ascertain its profile on the northern and southern routes between those countries; the time allotted not permitting a thorough examination for scientific purposes.

Specimens of the bottom, however, were obtained with all soundings, and serial temperatures, when practicable; the surface and under currents were also ascertained when the circumstances would allow.

The Tuscarora arrived at the navy-yard, Mare Island, Cal., June 27, 1873, when the work of preparing her for the sounding-cruise was commenced. A portion of the battery was landed, a chart-house was erected on deck, and such sounding-machines and stores were supplied as could then be furnished. These preparations were completed in the early part of August, and the vessel proceeded on an experimental trip off San Francisco, to test the working of the machines, and to remedy any defects that might be discovered, before commencing to run a line of soundings.

Eleven casts were made on this trip with both machines, which determined the superiority of Sir William Thomson's machine and piano-wire over the steam reel and rope. The vessel then returned to the navy-yard; and, after such alterations and improvements in the sounding-machines and instruments were made as were suggested by experience, she proceeded to the Straits of Juan de Fuca to commence the first line of soundings on the great-circle route from Cape Flattery to Japan.

This line was commenced September 17, and the great-circle route was followed as nearly as the winds and currents would permit. Thirty-four casts were made, the last in latitude 53° 58′ N., longitude 153° 00′ W., when the vessel was compelled to return for coal to Victoria, Vancouver Island. On account of the lateness of the season, it was determined to defer the completion of this line until the following year; and it being deemed desirable to ascertain the continental outline, or the commencement of the ocean-bed proper, of the west coast of the United States, the vessel left the Straits of Juan de Fuca October 17, and commenced running lines of soundings off and on shore between Cape

6 self-registering thermometers, (Saxton's.)
1 standard thermometer.
1 photographic apparatus.
1 microscope.
100 glass bottles for specimens of the bottom.
4 cans of caustic soda for preserving the wire.
Drawing-instruments and materials.
Surveying-instruments.

After the superiority of Sir William Thomson's machine had been proved by experience, and the invention of the sounding-cylinders by Commander Belknap, some of the instruments and appliances given in the list of outfit were not required, and were placed in store at the navy-yard. The supply of articles was kept up from time to time as required.

## DESCRIPTION OF SOUNDING-MACHINES, ETC.

### SIR WILLIAM THOMSON'S SOUNDING-MACHINE, (ORIGINAL PATTERN.)

A general side-elevation of this machine is shown in Plate XVII. It consists of a hollow, circular drum, *a*, for the piano-wire; a counter, *b*, to indicate the revolutions of the drum; a dynamometer-wheel, *c*, and dynamometer, by means of which the tension on the wire plus the friction is measured; a platform on which the drum, the dynamometer-wheel, and dynamometer are secured; and an endless rope, with its pulley-wheel and pendant attachments.

The drum is made of galvanized sheet-iron, and is securely soldered to a small iron shaft, which passes through its center. Its circumference is six feet, so that each of the first turns of the wire is a fathom in length. The sides of the drum are extended, forming the rims of a score three inches wide and two inches deep, in which the wire is reeled.

A projection of galvanized iron, attached to the right side of the drum, (looking from the dynamometer toward the drum,) forms the V-groove around which the endless rope is passed. To the shaft on the left side of the drum is secured a ratchet, in which a pawl works to keep the drum from turning when it may be desirable. The left end of the shaft is fitted with a square shoulder for a crank to reel up the wire when not sounding; and the shaft revolves in trunnion-holes at the upper end of two iron braces, which are bolted to the platform. The drum weighs about 60 pounds. To the left brace of the drum is screwed a plate of iron to attach the counter, which consists of a rectangular box of brass, containing cog-wheels of different diameters, so arranged that they work the hands of the three dials on one face of the box, showing the number of revolutions of the drum in tens, hundreds, and thousands. The motion is given to these wheels by a wormed wheel of brass, which is secured to the shaft of the drum.

The dynamometer-wheel is made of iron ten inches in diameter, and has two grooves on its rim: one wide enough to hold two parts of the endless rope; and the other narrower, to receive a cord. It revolves in

an iron crotch secured to an upright block of wood fastened to the platform in rear of the drum, so that the wheel and V-groove of the drum are directly in line. The dynamometer is constructed on the principle of the spring-balance. The case is made of iron, is bell-shaped, and on one face has a graduated scale in pounds, with a pointer, which is connected with the springs in the interior of the case, so that when a tension is brought upon the springs the pointer shows on the graduated scale its amount. The dynamometer is secured to a block of wood which is fastened to the platform alongside the block for the dynamometer-wheel. The dynamometer and dynamometer-wheel, when required for use in sounding, are connected by a cord or check-line, which rests in the narrow groove in the rim of the wheel, and passes down through a hole in the rim of the wheel, and is secured to an eye in the end of a rod, which is attached to the springs of the dynamometer. Then, as the dynamometer-wheel turns by the action of the endless rope, the cord acts upon the rod, which extends the springs, moving the pointer, and showing on the graduated scale the number of pounds of tension.

[An ordinary spring-balance was substituted for the dynamometer described above.]

The platform is made of hard wood, 3½ feet in length, 1½ feet wide, and 2½ inches thick. To the forward end of the platform is secured a lignum-vitæ clamp, through which the wire passes, and which may be used to clamp the wire when desirable.

The endless rope is made of 9-thread Albacore-line, untarred hemp, and is attached to the machine in the following manner: One bight of the rope is placed in the outer edge of the V-groove in the drum, and the part leading from the bottom of the drum is taken up over the dynamometer-wheel, and once around it, and the other bight of the rope is kept taut by being placed over a pulley-wheel to which a pendant is attached, which is rove through a stationary block, and to the other end of the pendant hooks are seized, to which weights are attached.

The object of the endless rope is to produce friction on the drum, by which the running-out of the wire may be regulated, and to connect the drum and the dynamometer so that the tension on the wire, making allowance for friction, may be measured. It was also used at first to reel up the wire in sounding.

The above description is that of the machine originally furnished to Commander Belknap for sounding with piano-wire, with the exception of the weight-attachments to the pendant, which he adopted in place of the tackle, for keeping the pendant taut. Experience suggested other improvements, such as the strengthening of the drum, which was found too weak, and the adoption of a separate reel for reeling up the wire in sounding. Commander Belknap recommends the construction of a steel drum, which he thinks may be made to withstand any strain that may be brought upon it in sounding, and which will otherwise work successfully.

The reeling-in apparatus, which, with the flying-bridge, was designed and constructed by Carpenter Jos. L. Thatcher, of the Tusarcora, is represented in Plate XVIII.

Fig. 1 shows a section through reel: *a* and *a′* are spokes of white pine placed at intervals around the inside of the drum, as shown in Fig. 2, fitting snugly to the shape of the inside of the drum; *b* and *b′*, disk of white pine made to fit inside circle of face, cutting through the spokes; *c* and *c′*, clamps of iron used to hold the reel in proper position; *d*, bed for reel to slide in, made any length to suit; *e* and *e′*, rivets or screws. Fig. 3 is a section through friction-roller stand, and Fig. 4 is an end-elevation of the reeling-in apparatus. In Plate XVII, the dotted line represents the belt or rope for reeling in, which is placed over the V-groove of the drum, and the groove of the reeling-in apparatus. This rope is made of 15-thread tarred hemp, well stretched, fitted with eyes and laniard. In fitting the eyes, a few of the yarns are taken out, and strands of annealed wire laid in to make the parts of the eyes and lashing uniform in size with the rest of the line, so as to run smoothly, and prevent the tendency to jump. The eyes should be served and examined frequently, as the strain upon them is very great, and they soon wear out. When not in use, the rope should be kept dry, working much better in that condition than when wet.

### SOUNDING-MACHINE FOR ROPE.

This machine is represented in Plate XIX, which was made from a rough sketch taken on board the Tuscarora. A machine working on the same principle was designed by Passed Assistant Engineer T. W. Rae for use with piano-wire, but this was afterward altered, in obedience to orders, for use with sounding-line. It was originally constructed for the Juniata, which vessel was detailed to run lines of soundings in the North Atlantic, and on the change of her orders the machine was sent to the Tuscarora. In Plate XIX, *a* and *a′* are two fixed elevated sheaves, over which the line passes. Midway between these sheaves there is another one, *b*, riding on the line, which is attached to a rod, *c*, moving vertically in a standard, *d*, and having at its lower end a piston, *e*, moving readily in a cylinder, *f*, which is filled with water or oil to prevent violent and vibratory motion of the dynamometer. The rod *c* is so fitted that weights, *w*, may be attached, which serve to measure the strain on the line. The weights are small, so that they can be added one by one as the weight of the line overboard increases, and a uniform strain may be kept continually upon it. By carefully regulating the weights, surplus line may be prevented from running out when the sounding-apparatus strikes the bottom. If the weighted pulley did not ride on the line it would stretch straight between the sheaves *a* and *a′*. It, however, depresses the line a certain distance, which corresponds to a given strain on the calculated scale *g*. The sounding-line is wound upon the reel *h*, and leads from the reel to the drum *j*, around which several turns are taken, and then leads over the sheaves *a′* and *a* to the sheave *k*, in the end of

out-rigger *l*, and the end is attached to the sounding-apparatus. The drum is controlled by a break, and the number of revolutions, from which the quantity of line out is calculated, is shown by a counter at *m* For reeling-in, a small engine, *n*, couples to the drum. To keep the turns from riding on the drum, there is a plough-edge at *o*, but by experience it was found necessary to lead the line through fair leaders at *p* and *p'*. The drum, as originally designed, had two plough-edges, which would have obviated the use of the fair leaders, and it was intended that the line should lead from the upper instead of the under side of the drum. This machine was used at first in taking some of the soundings at moderate depths, and in taking serial temperatures; but it was afterward landed at the navy-yard, and a duplicate Thomson's machine was placed on the forecastle for obtaining temperatures.

### SANDS' SPECIMEN-BOX FOR DEEP-SEA SOUNDINGS.

Plate I, Figs. 1 and 2.

A key, *a*, secures the tenon *b* into the bottom of the deep-sea lead, into which tenon is screwed the tube *c*, (which is conical at the lower end for penetrating the bottom,) over which moves a cylindrical sliding-valve, *d*, with flange, *e*, which, resting on the bottom when the lead reaches it, is pushed up above the elliptical hole *f* in the side of the tube for the admission of the specimen, and closed by the spiral spring *g*, (when the lead is free from the bottom,) which keeps it firmly down on the rest-pin *h*, preventing the washing-out of the specimen in the jerking motion of hauling in the line by hand. The tube is unscrewed from the tenon, and the specimen emptied out at the upper end.

### SANDS' DEEP-SEA SOUNDING-APPARATUS.

Plate II.

The rod *a a* is of half-inch round wire, about 18 inches long, with a swivel on the upper end for the lead-line, and a socket at the lower end to receive the tenon of the specimen-tube *b*, fastened by the key *c*. Two wire-rods, *f*, about a foot in length, on each side of the rod connect the flange *g* of the specimen-tube with a small band, *h*, around the rod, having two spurs pointing downward. Surrounding the sounding-rod are two semicylindrical weights of cast iron, *e*, *e*, grooved on the flat-sides to receive the rod, and to allow the valve-connecting rods to play freely between the weights. Holes of three-fourths of an inch diameter are drilled in their lower ends to receive the plugs *d d* that are hinged upon the ends of the key *c*, and which keep the weights in their seat; and in their upper ends, of one-fourth inch in diameter, to receive the small spurs of the band *h*, which confine the upper ends of the weights to the sounding-rod. In the act of the specimen-tube piercing the bottom, the sliding-valve of the tube is raised to admit the specimen, lifting also the band *h* connected with it by the wire-rods *f*, releasing the upper ends of the weights, and causing them to fall free from the rod, leaving nothing

but the rod and specimen-tube to be brought on board. The upper portion of the sounding-rod is flattened, and pierced with two holes, to allow the self-registering indicator (Plate III) to be clamped to it.

### BROOKE'S DEEP-SEA SOUNDING-APPARATUS.

Paltes IV and V.

In Plate IV, Fig. 1, is shown the detaching-apparatus; Fig. 2, the lead ready for sounding. Plate V, Fig. 1, shows the shot in the act of detaching; Fig. 2, the slings. *a* is a shot cast with a hole through it and slight grooves on its sides to receive and steady the slings *e*.

*b* is a rod, to which is attached an arm, *c*.

*c* is an arm moving vertically about the pin *d*, and from which the shot *a* is suspended by the slings *e*.

*e*, slings and washer, which are thrown off with the shot.

The lower end of the rod is tubular, receiving the barrels of several goose-quills, open at both ends, retaining their places by their elasticity.

*f* is a valve of thin leather, opening outward, permitting the water to flow through the quills *q* as the rod descends, and closing as it is drawn up.

The original sounding-apparatus, invented by Brooke, had a double-armed detachment at *d*, which required nicety of construction and manipulation to insure its working, and Brooke then constructed the single-armed detachment, which has proved so successful. He afterward designed a registering-apparatus, to indicate the number of fathoms of descent of the weight, which was attached to the link *h*, and to the upper end of which was attached the sounding-line. This, like all similar self-registering instruments, is of no practical use for great depths.

### THE FITZGERALD SOUNDING-MACHINE.

Plate VI.

The following description and accompanying plate of the Fitzgerald sounding-machine are taken from "The Depths of the Sea," by Prof. C. Wyville Thomson:

The sounding-line is attached to the center of the bar of iron *f*. The bar terminates at one end in a claw, and at the other in an eye, to which the chain *g* is attached. A scoop, *a*, with a sharp, spade-like lip, is fixed to a long and rather heavy iron rod, *d*, with an expanded rudder-shaped end, *h*, to steady it in passing quickly through the water, and beneath this an eye, which fits the claw of the bar *f*, as at *i*. A door, *b*, fits the scoop, to which it is hinged, and it is also hinged to the arm *c*, which, when held in a vertical position, keeps it open. The arm *c* is attached to the bar *f* by the chain *g*, and the arm and chain correspond in length to the rod *d*. Two teeth, *e*, *e*, project from the rod *d*, and on these is hung the weight *k*. The apparatus is so adjusted that when

the weight is attached, and the instrument hanging, ready for use, as represented in the figure, the rod *f* maintains a horizontal position. When the instrument strikes the bottom, the tension on the bar *f* is relieved, the weight draws the rod *d* off the claw, and slips off, at the same time filling the scoop. When hauling up, all of the instrument falls into a nearly vertical line, and the scoop comes up full in the middle, the weight of *d* keeping its mouth closed up against its lid.

Professor Thomson says in regard to this machine that he never knew it to fail; but Commander Belknap reports that "it does not impress me favorably; the form is irregular, and the open scoop opposes so much resistance to the water that it does not go down straight; it also gets the line full of turns, is hard to haul in, owing to its form and weight, and the sinker is apt to slip off." This machine, as furnished to the Tuscarora, weighed 11½ pounds.

### THE BROOKE-SANDS SOUNDING-APPARATUS, AS FIRST MODIFIED BY COMMANDER BELKNAP.

This instrument is represented in Plates VII and VIII: *a* is the Sands cup; *b*, Brooke's washer and laniard; *cc'*, modification of Brooke's movable arm; *f*, movable socket for shoulder of sinker; and *g*, screw for clamping movable socket.

The Sands cup was made larger and with lighter spring, and reduced one pound in weight. In place of the movable arm of the Brooke attachment, one ring traversing within another was substituted, by means of which the laniard and washer are saved. The socket inclosing the upper ends of the split sinker, when the apparatus is ready for use, is movable, and kept in any position by the screw *g*, so that sinkers of greater or lesser weights can be attached, and the Sands sinkers are cast with the shoulders *e* fitting into the socket *f*. The weight to haul up is 4½ pounds.

### BELKNAP DEEP-SEA SOUNDING-CYLINDER NO. 1, WITH BROOKE'S DETACHING-ROD AND SINKER.

Plates IX and X.

The sliding-cylinder *b* traverses freely over the cylinder *a a*, and in sounding is held up by the lug *h* resting on the shot. The rod *c* terminates in a cone, *l*, which screws into the cylinder *a'*. In descending, the water passes freely in through apertures *p p'*, up through holes *n n'*, into chambers *m m'*, thence up through outlets *i i* and *r r*; upon touching the bottom, the shot falls and disengages in the usual manner. Cylinder *b* also drops, assisted by friction of shot, and closes apertures *p p'*. The shoulders *j j'* bear on outer surface of cylinder *a*; the rest of the inner surface of outer cylinder being turned out, as shown at *k*, and upward, to decrease friction and prevent particles of sand from jamming it. *g g* are leather valves. Upon hauling up the line, the pump-valves *o o'* and the valves *g g* close, and the cylinder comes up as shown in Plate

X, Fig. 1, and brings up both mud and water from the bottom. The ring *w* is clamped to the rod *c* by the screw *x*, and prevents the outer cylinder from going so high as to clear the inner cylinder. Being adjustable, it can be set for either the XI-inch or VIII-inch shot. The cylinder; *a* unscrews from *a'* to enable the specimens to be taken out easily; and it also forms a shoulder to keep the valve *n* in place. The valve *n'* screws into the cylinder from above. These cylinders can be made any size desired; the sinkers to be cast with holes accordingly. To save the sinker in shoal water, the cup of the inner cylinder might be made in duplicate, as shown in Fig 3, Plate IX; the latter having a pin like that in the Sands cup running through and projecting from the outer surface, so as to catch the sinker and prevent its dropping off. The mud would act as a cushion to ease the shock and save the pin from bending or breaking.

### BELKNAP DEEP-SEA SOUNDING CYLINDER NO. 2.

Plates XI and XII.

*a* is a cylinder, which screws into the casting *b* at *b'*, the lower part of which is bored out to form the tube. *c* keeps the valve-plate *e* from ing up any higher. *f* and *g* are lifting-valves, with leather washers. The plunger *h* is kept in position by its own weight and the force of the light spring *k*. The rod *l* screws into the casting *b* at *l'*. When the cylinder strikes the bottom, detaching the shot, the plunger *h* is forced upward, admitting mud and water. The water in its flow upward escapes through the holes *m* and *n*, lifting the valves *f* and *g*, and, upon hauling up the cylinder, the valves close and the plunger drops down. The specimens brought up are readily gotten out by unscrewing the casting *b* at *b'*, when the entire interior mechanism comes out. The screw *p* seems to make little or no difference in the working of the plunger in muddy bottom, but would be of more service if hard bottom was met with.

### BELKNAP DEEP-SEA SOUNDING CYLINDER NO. 3.

Plates XIII and XIV.

The auger-twist *a*, terminating in the cup *b*, revolves at the swivel-joint *j* in the casting *c*, and is kept from unscrewing by the pin *p*.

The cylinder *e* is kept up by the lug *l*, resting on the shot or sinker *s*. In descending, the water flows upward through the holes *m m'* and *n n'*. When the bottom is reached, the sinker and cylinder fall, the former detaching in the usual manner, and the latter fetches up at the shoulder *t*, and the shoulder *h* of the cylinder brings up snugly around the edge of the cup *b*. The cup and twist offering no obstacle, and in very deep water when the tension on the wire or line prevents the sinker from striking with full force, this machine generally brings up a better specimen than cylinders Nos. 1 and 2. Though the screw is made to turn at the joint *j*, it does not seem to be necessary, as in practice, using the wire, there seems to be no tendency to twist.

In hauling back, the valves *v* and *v′* close. The cup and screw, being made of iron, should be galvanized. The laniards are attached to the shot or sinker, as shown in Plate XIV, to prevent the use of the Brooke washer, which is liable in detaching to catch in the twist near the cup. The dotted lines in Plate XIV show the laniards fitted with small iron rings in place of the wire eyes, which do not so easily detach from the arm.

### BELKNAP'S COASTING-LEAD.

Plates XV and XVI.

The lead *a* is fastened to the brass cylinder *b* by the screws *s s′*. When set for use, the laniard *e* raises the lead *a*, and hooks on the Brooke attachment *f*. In descending, the water flows freely in through the apertures *g g′* of the cup *c*, and upward through the holes *h h′* and *i i′*, and out through the holes *j j′*. The ring *k* and the screw *l* keep the lead from going too high up the rod *r*. When bottom is reached, the lead *a* drops down over the cup *c*, closing the apertures *g g′*, and the curved end of the cylinder *b*, shutting closely down over the holes *h h′*, acts as a valve to shut the water off, preventing the specimen from washing out. By making the cylinder proportionally larger, it could be made of cast iron, and galvanized to prevent rust; and the expense of the cylinder *b* would be saved, as the sinker, being of hard metal, could be cast so as to fit and slide over the cup. The dotted lines suggest a modification of form if desirable. As the cylinder *b* shuts closely over the holes *h h′*, the leather valves *v v* can be dispensed with.

Cylinder No. 3 was designed for use in localities where ooze, mud, or clay is found, and with such a bottom could hardly be bettered. On hard, sandy, or gravelly bottom, cylinder No. 2 was found generally to bring up the best specimen. Cylinder No. 1, also, did excellent service, especially in mud and ooze.

## DESCRIPTION OF THE PIANO-WIRE, SOUNDING-LINES, ETC.

The piano-wire furnished is known as No. 22, Birmingham gauge. It comes in lengths of from 200 to 400 fathoms, and is spliced together by overlapping the ends about two feet, soldering one end, and laying the other end up so that each turn will take up one inch of the wire, and as soon as all the wire is expended the end is soldered. The two parts are also soldered together at three or four intermediate points between the ends, and the whole splice is tightly served with well-waxed flax twine.

The wire weighs 14 pounds in air and 12 pounds in water to the statute-mile, and the breaking-strain of English wire is about 230 pounds and of American 195 pounds. When it breaks at great depths, it draws down to two-thirds of its normal size before parting, and Commander Belknap suggests the use of a larger wire for depths beyond 4,000 fathoms. It is preserved from rust when new by being kept in sperm-oil, and, after it has been used, by keeping it covered with a solution of caustic soda.

The sounding-lines furnished were of various kinds and sizes, as shown in the list of sounding-outfit. In testing these lines, the 1¼-inch Manilla whale-line bore a steady strain of 1,830 pounds with a length of 2 fathoms between seizings, and the Albacore line bore a strain of 520 pounds with the same length between seizings. A greater portion of the sounding-line was carbolized to prevent rotting, but it was found that this did not answer the purpose intended, and besides weakened the line. The following table shows the test of the carbolized line:

| Size in inches. | Kind. | Length in fathoms. | Breaking-strain in pounds. | Length between seizings in fathoms. | Time of hanging. | Weight of ten fathoms in air in pounds. |
|---|---|---|---|---|---|---|
| 1¼ | Hemp | 12,000 | 1,180 | 2 | 10 seconds | 3½ |
| 1¼ | ....do | 8,000 | 1,250 | 2 | 2 minutes 15 seconds | 3½ |
| 1½ | Hemp, (cable-laid) | 3,000 | 1,480 | 2 | 3 minutes | 5¼ |
| 2¼ | Manilla | 9,000 | 2,600 | 2½ | 9 minutes 40 seconds | 8¼ |

The lines were marked as follows: At every 50 fathoms, with a knot; and at the first hundred fathoms, with a red rag; second hundred, white; third hundred, red and blue; fourth hundred, blue and red; fifth hundred, red and white. Commencing again, the sixth hundred is marked with a red rag; and so on, adding one knot for each 500 fathoms, beginning from second five-hundred mark.

The sinkers furnished were bored 32-pounder, VIII, XI, and XV-inch shot, the holes being 2¼ and 2½ inches in diameter; also square sinkers, from 18 to 30 pounds, for the Fitzgerald apparatus, and split sinkers, from 20 to 300 pounds a pair.

In the Brooke apparatus, the shot is supported by a washer with laniards attached, which go over the detaching-arm of the sounding-rod; but, with the Belknap cylinders, it was found best to do away with the washer, which, in detaching, sometimes catches between the cup and the screw, and this is obviated by attaching the laniards to the shot, either by having the shot fitted with lugs, or by slinging it by making two grommets, of small-sized, annealed wire, of a little less diameter than that of the shot, and securing them on it perpendicular to the hole by passing a lacing between the grommets after the manner of drum-head-hoops and lacing. The laniards can then be secured to the lower grommet, (see Plate XIV.) With the piano-wire, and at moderate depths, say 2,500 fathoms, the VIII-inch sinker, (hole, 2¼ inches,) weighing 55 pounds, was principally used. At greater depths, the weight of sinker was increased from 15 to 20 pounds by attaching castings of lead to fit over the upper half of the sinker.

With rope, 1¼-inch Manilla whale-line and Albacore line, sinkers weighing from 300 to 400 pounds were used in depths over 1,200 fathoms.

## METHOD OF SOUNDING WITH SIR WILLIAM THOMSON'S MACHINE AND PIANO-WIRE.

In preparing to sound, if the ship be under sail, steam is gotten up and the machine is placed on the flying-bridge athwartships, and properly secured there, so that the wire, which has been previously reeled upon the drum, will lead fair from the drum and clear of the ship's side. To reel up the wire, the counter is placed in its position on the axle of the drum, and the inner end of the first hank is securely attached to the drum, a hole being drilled in the rim for the purpose. The wire is then carefully reeled up, being measured as it is wound upon the drum, until the end of the hank is reached, and this end is spliced to the end of the second hank in the manner previously described, and this process is continued until the required amount of wire is upon the drum.

In handling the wire, whether measuring or splicing it, or paying it out, great care is observed to prevent its kinking; and in measuring and reeling in, it is kept hand-taut. In reeling in the wire on the drum, the number of revolutions corresponding to each splice and the number of fathoms between the splices are noted in a book for future reference.

The machine having been secured in its place on the bridge, the endless rope is passed, as previously described, and the weights are attached to the pendant, and the dynamometer-wheel and dynamometer are connected by a cord, as described on page 6. The machine is now ready for sounding, with the exception of attaching the wire to the specimen cylinder, which is done in the following manner:

To prevent the wire from touching the bottom and kinking, a stray-line, 25 fathoms in length, made of ¾ inch Albacore line, intervenes between the wire and the cylinder. The end of the wire is secured to a rope grommet, made of 1½ or 2 inch rope, by sticking the wire through the strands of the grommet, and taking half a dozen round turns against the lay, and serving the whole neatly. A small, oval-shaped lead, weighing 4 pounds, and fitted with laniards, is attached to the grommet opposite to the wire by one of its laniards, and the other one is made fast to the upper end of the stray-line. (The object of this lead is to prevent the end of the wire from turning up and kinking when the strain on the wire has been relieved by the apparatus resting on the bottom.) The lower end of the stray-line is secured to an eye in the upper end of a rod of stout wire, one-eighth inch in size, and a fathom in length, and an eye in the lower end of the rod is seized to the swivel-link in the upper end of the sounding-cylinder, on which the weight or sinker has been placed, with its laniards over the detaching-arm. Thus, between the end of the wire and the specimen-cylinder there is a grommet, an oval-shaped lead, the stray-line, and the iron rod; the rod falls down when the apparatus strikes the bottom, and takes the stray-line clear of the apparatus, and prevents fouling. These preparations having been made, the ship is brought stern to the wind, and kept in that position by the backing of the engines. In the Tuscarora, it was found that this was the best method of heaving to the vessel for sounding, and in some instances it was done when the force of the wind was as great as 8, and with a

heavy sea running. When the ship has become steady, the sounding-apparatus is carefully lowered into the water by hand, the self-registering thermometer, for ascertaining the bottom-temperature, is attached to the stray-line; and the line is permitted to run out until the wire is reached, when the latter is clamped in the lignum-vitæ clamp. The weights on the pendant are now adjusted so that the friction of the endless rope on the drum will keep it from turning but slowly when the wire is unclamped. A careful petty-officer is stationed to attend to the putting on and removing of the weights.

Everything being ready, the officer in charge of the machine directs that the wire be unclamped, and it is permitted to run out slowly at first, and, when well started, some of the weights on the pendant are removed to allow the wire to run more freely; but it is never allowed to run out faster than from 90 to 100 revolutions per minute. The weights on the pendant, at first, generally aggregate 90 pounds, the indications shown by the dynamometer being 37 pounds; and when the wire is running out at the greatest speed admissible, the pendant weight is 25 pounds, and the dynamometer shows 15 pounds. Sometimes, when the vessel is rolling badly, the drum will almost stop, and in a moment start again more rapidly than ever; but in this case, the too rapid running-out may be checked by pressing the hand down on the endless rope.

When it is judged that the cylinder is nearing the bottom, the revolutions of the drum are decreased by increasing the weights on the pendant to 90 or 100 pounds, the dynamometer showing from 35 to 40 pounds; and the moment of the cylinder's striking the bottom is shown by the action of the dynamometer and the cessation of the revolutions of the drum. When the cylinder reaches the bottom, a few turns are allowed to run out, but not enough to allow the wire to reach bottom and kink.

The cord is then cast off from the dynamometer-wheel, to allow it to turn freely, and the officer in charge takes hold of the endless rope and hauls in until he thinks the cylinder is off the bottom with the sinker detached; the men then man the rope and reel in 50 fathoms, when the officer again tries the line himself, and, if still satisfied that the sinker has been detached, the wire is clamped, the endless rope taken off, the dynamometer-wheel unshipped, and the belt or rope passed from the drum to the reeling-in-apparatus, as shown in the dotted line, Plate XVII. All being ready, the men go to the cranks of the reeling-in-apparatus, the wire is unclamped, and the reeling in is begun, slowly at first, but after a little while as fast as the men can do it. In reeling in or paying out, petty-officers stand on the platform outside of the ship on each side of the drum, with round sticks in their hands, to guide the wire fair; the inner ends of the sticks are lashed to the rail of the platform, so that in case it is necessary the men may let them go for a time.

When the self-registering thermometer arrives at the platform, it is cast off from the stray-line and its reading noted; and when the specimen-cylinder comes to hand the line is unbent from it, and the specimen of the bottom is removed and put in bottles, which are properly labeled, with the date, number of cast, and the latitude and longitude.

The stray-line is now unbent from the wire; the counter removed from the drum; the drum is unshipped and placed in a tub containing a solution of caustic soda, which is renewed from time to time; and the machine is taken down and stowed in a secure place.

In reeling in, a pan of the solution of caustic soda and a hand-swab are kept near the drum to wet the inner turns of the wire. The caustic soda preserves the wire, but eats up the solder on the splices, requiring a renewal of it occasionally.

Both in running down and reeling in, an officer is stationed to note the time of every 100 revolutions, and also the number of the splices.

The revolutions must not be confounded with fathoms; for, though the first turns on the drum will be a fathom for each one, the diameter is constantly increasing, and therefore, after the first layer or two of wire is on, there is a slight gain in the length of the wire for each turn.

The following table will perhaps make the matter clear:

| Number of splices. | Number of revolutions. | Number of fathoms. | Gain of fathoms. | Rates of gain. |
|---|---|---|---|---|
| 1 | 240 | 242 | 2 | 1 fathom to 120 revolutions. |
| 2 | 500 | 510 | 10 | 1 fathom to 32½ revolutions. |
| 3 | 800 | 820 | 20 | 1 fathom to 30 revolutions. |
| 4 | 1,200 | 1,230 | 30 | 1 fathom to 40 revolutions. |

When bottom is reached, the counter is read and the number of revolutions is noted. In reeling in, and when the last splice out has come back to the reel, the counter is again read. This number of revolutions gives the splice, and by looking at the table the corresponding number of fathoms is found. Then the difference between the whole number of revolutions and the number of revolutions at the splice is taken, and, by interpolating, the number of fathoms corresponding are found.

EXAMPLE.

Bottom: Number of revolutions, 850.

Splice: Number of revolutions, 800 by table.

Third splice.

Difference between whole number of revolutions and revolutions of splice, 50.

Gain by table, 20 nearly.

Length of wire out, 872.

Stray-line, minus height of reel from water, 25.

Depth, 897 fathoms.

Now, when the machine is put into use, the weight of the wire out tends to wind it very tightly on the drum as it comes in; therefore there is a constant change in the number of revolutions, sometimes gaining, sometimes losing, so that equal revolutions do not give equal numbers of fathoms; hence the necessity for the table.

The journal of soundings is kept as in the form shown on page 18, which is a copy of one of the soundings of the Tuscarora.

*Journal of deep sea soundings, North Pacific Ocean, by United States steamship Tuscarora, Commander George E. Belknap, commanding; Yokohama, Japan, to Cape Flattery, via Aleutian Islands.*

### CAST No. 28.—JUNE 17, 1874.

| | |
|---|---|
| Number | 28. |
| Hour | 9 h. 50 m. 54 s., a. m. |
| Wind | Variable. |
| Force | 0.5 to 1. |
| Weather | b c f clouds, cirrus. Prop. clear, 8. |
| Sea | Smooth. |
| Line | Piano-wire, No. 22. |
| Sinker | 8-inch shot and 19 lbs. lead weight on casting. |
| Weight | 74 lbs. |
| Machine | Sir William Thomson's. |
| App. for spec. | Belknap cylinder, No. 1. |

Latitude, 42° 57′ N., obs.
Longitude, 148° 23′ E., chro.
Barometer, 30.18; ther. att'd, 55°.8.
Temperatures:
Air, 54°.6, D. B.; 55° W. B.
Sea-surface, 49°.5.
Under-surface 700 fms., 34°—0°.49=33°.51. (18143.)
Depth, 4,356 fms.
Bottom, yellowish mud with sand and specks of lava.
Surface-current, 3 fms. N. E.
Under-current:
10 fms., 3 fms. NE. by N.
20 fms., ½ fms. N. W.
30 fms., 1 fm. W.
50 fms., 1½ fms. W.
100 fms., 2 fms. W. by S.
200 fms., 6 fms. SW. by S.
Value of sounding, undoubtedly good.

Current shown by observation during past 24 hours, N. 45° E., 3 fms. per hour.

| Fathoms or revolutions. | Time. | | | A. m. or p. m. | Interval. | | 2d Diff. | | Time hauling in. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hour. | Min. | Sec. | | Min. | Sec. | Min. | Sec. | Hour. | Min. | Sec. |
| | 9 | 50 | 54 | a. m. | | | | | | | |
| 100 | 9 | 52 | 02 | a. m. | 1 | 08 | | | | 1 | 12 |
| 200 | 9 | 52 | 53 | a. m. | | 51 | | 17 | | 1 | 08 |
| 300 | 9 | 53 | 43 | a. m. | | 50 | | 1 | | 2 | 02 |
| 400 | 9 | 54 | 33 | a. m. | | 50 | | | | 1 | 21 |
| 500 | 9 | 55 | 25 | a. m. | | 52 | | 2 | | 1 | 29 |
| 600 | 9 | 56 | 19 | a. m. | | 54 | | 2 | | 1 | 26 |
| 700 | 9 | 57 | 14 | a. m. | | 55 | | 1 | | 1 | 29 |
| 800 | 9 | 58 | 10 | a. m. | | 56 | | 1 | | 1 | 28 |
| 900 | 9 | 59 | 07 | a. m. | | 57 | | 1 | | 1 | 52 |
| 1000 | 10 | 00 | 08 | a. m. | 1 | 01 | | 4 | | 1 | 59 |
| 1100 | 10 | 1 | 11 | a. m. | 1 | 03 | | 2 | | 1 | 59 |
| 1200 | 10 | 2 | 16 | a. m. | 1 | 05 | | 2 | | 1 | 48 |
| 1300 | 10 | 3 | 22 | a. m. | 1 | 06 | | 1 | | 1 | 54 |
| 1400 | 10 | 4 | 29 | a. m. | 1 | 07 | | 1 | | 2 | 02 |
| 1500 | 10 | 5 | 36 | a. m. | 1 | 07 | | | | 2 | 07 |
| 1600 | 10 | 6 | 47 | a. m. | 1 | 11 | | 4 | | 2 | 19 |
| 1700 | 10 | 7 | 57 | a. m. | 1 | 10 | | 1 | | 2 | 20 |
| 1800 | 10 | 9 | 10 | a. m. | 1 | 13 | | 3 | | 2 | 00 |
| 1900 | 10 | 10 | 23 | a. m. | 1 | 13 | | | | 2 | 04 |
| 2000 | 10 | 11 | 37 | a. m. | 1 | 14 | | 1 | | 2 | 08 |
| 2100 | 10 | 12 | 53 | a. m. | 1 | 16 | | 2 | | 2 | 10 |
| 2200 | 10 | 14 | 10 | a. m. | 1 | 17 | | 1 | | 2 | 18 |
| 2300 | 10 | 15 | 28 | a. m. | 1 | 18 | | 1 | | 2 | 19 |
| 2400 | 10 | 16 | 47 | a. m. | 1 | 19 | | 1 | | 2 | 11 |
| 2500 | 10 | 18 | 07 | a. m. | 1 | 20 | | 1 | | 2 | 37 |
| 2600 | 10 | 19 | 24 | a. m. | 1 | 17 | | 3 | | 2 | 43 |
| 2700 | 10 | 20 | 43 | a. m. | 1 | 19 | | 2 | | 2 | 27 |
| 2800 | 10 | 22 | 00 | a. m. | 1 | 17 | | 2 | | 2 | 15 |
| 2900 | 10 | 23 | 23 | a. m. | 1 | 23 | | 6 | | 2 | 14 |
| 3000 | 10 | 24 | 45 | a. m. | 1 | 22 | | 1 | | 2 | 51 |
| 3100 | 10 | 26 | 09 | a. m. | 1 | 24 | | 2 | | 2 | 49 |
| 3200 | 10 | 27 | 33 | a. m. | 1 | 24 | | | | 2 | 47 |
| 3300 | 10 | 29 | 01 | a. m. | 1 | 28 | | 4 | | 2 | 41 |
| 3400 | 10 | 30 | 43 | a. m. | 1 | 42 | | 14 | | 2 | 40 |
| 3500 | 10 | 32 | 25 | a. m. | 1 | 42 | | | | 2 | 56 |
| 3600 | 10 | 34 | 05 | a. m. | 1 | 40 | | 2 | | 2 | 54 |
| 3700 | 10 | 35 | 55 | a. m. | 1 | 50 | | 10 | | 2 | 31 |
| 3800 | 10 | 37 | 48 | a. m. | 1 | 53 | | 3 | | 2 | 50 |
| 3900 | 10 | 39 | 46 | a. m. | 1 | 58 | | 5 | | 2 | 59 |
| 4000 | 10 | 41 | 51 | a. m. | 2 | 05 | | 7 | | 2 | 51 |
| 4071 | 10 | 43 | 30 | a. m. | 1 | 39 | | | | 2 | 02 |
| Time going out | | | | | 52 | 36 | Com'g in | | 1 | 30 | 10 |
| Finished | | | | | | | | | 12 | 17 | 51 |
| Total time of cast | | | | | | | | | 2 | 26 | 57 |

p. m.

**Remarks.**

Fine calm weather; engines moved occasionally; Lieutenant F. M. Symonds went out in whale-boat to try under-surface currents.

Before beginning this cast, wound 706 fathoms more of wire on the reel. Reel so much strained by these deep casts that the wire will have to be wound upon a new one.

At end of cast kept on course under fore and aft sail, fore-sail, and steam; wind very light.

SERIAL TEMPERATURES.

Surface, 49°.5.
10 fms., 42°.7—0°.00=42°.7. No. 18145.
15 fms., 36°.5—0°.01=36°.49. No. 18145.
25 fms., 33°.6—0°.02=33°.58. No. 18145.
50 fms., 32°.7—0°.03=32°.67. No. 18143.
100 fms., 33°.4—0°.07=33°.33. No. 18143.
300 fms., 33°.8—0°.21=33°.59. No. 18145.
500 fms., 34°.5—0°.35=34°.15. No. 18145.
700 fms., 34° —0°.49=33°.51. No. 18143.

| Weights on pulley. | Dyn. ind. | |
|---|---|---|
| 125 lbs. | 48 lbs. | |
| 90 lbs. | 44 lbs. | 50 fms. |
| 65 lbs | 36 lbs | 70 fms. |
| 50 lbs | 30 lbs. | 90 fms. |
| 25 lbs | 18 lbs | 170 fms. |
| 40 lbs. | 18 lbs | 970 fms. |
| 90 lbs | 35 lbs. | 3,390 fms. |
| 112 lbs | 40 lbs. | 3,600 fms. |
| 150 lbs | 47 lbs. | 3,925 fms. |

Number of revolutions, 4,071.

| | |
|---|---|
| Number of measured fathoms | 4,331 |
| Stray line | 25 |
| Depth | 4,356 |

# TABLES OF DEEP SEA-SOUNDINGS,

# NORTH PACIFIC OCEAN,

OBTAINED IN

UNITED STATES STEAMSHIP TUSCARORA (THIRD RATE),

Commander G. E. BELKNAP, Commanding.

### SOUNDINGS ON EXPERIMENTAL LINE OFF SAN FRANCISCO.

| Date. | No. of cast. | Latitude. | Longitude. | Depth in fms. | Nature of bottom. | Remarks. |
|---|---|---|---|---|---|---|
| 1873. | | N. ° ′ | W. ° ′ | | | |
| Aug. 13 | 1 | 37 30 | 123 01 | 141 | Blue mud. | |
| | 2 | 37 28 | 123 13 | 830 | Blue mud. | |
| | 3 | 37 27 | 123 21 | 1015 | Blue mud. | |
| | 4 | 37 25 | 123 26 | 1195 | Blue mud. | |
| | 5 | 37 27 | 123 33 | . . | . . . . . . . . . . . . . | Rope broke. |
| | 6 | 37 27 | 123 33 | 1361 | Blue mud. | |
| Aug. 14 | 7 | 37 21 | 123 55 | . . | . . . . . . . . . . . . . | Not obtained. |
| | 8 | 37 21 | 123 55 | 1949 | Blue mud. | |
| | 9 | 37 24 | 123 38 | . . | . . . . . . . . . . . . . | Wire broke. |
| | 10 | 37 24 | 123 38 | . . | . . . . . . . . . . . . . | Wire broke. |
| Aug. 15 | 11 | 37 28 | 123 05 | 503 | Blue mud. | |

### SOUNDINGS OFF AND ON SHORE BETWEEN CAPE FLATTERY AND SAN FRANCISCO.

| Date. | No. of cast. | Latitude. | Longitude. | Depth in fms. | Nature of bottom. | Remarks. |
|---|---|---|---|---|---|---|
| Oct. 17 | 1 | 48 00 | 125 10 | 76 | Fine black sand and mud. | Line 1. |
| Oct. 18 | 2 | 47 47 | 125 20 | 118 | Black sand and gravel. | |
| | 3 | 47 45 | 125 27 | 360 | Clay with fine dark sand. | |
| | 4 | 47 43 | 125 37 | 570 | No specimen. | Line parted in reeling in. |
| | 5 | 47 41 | 125 45 | 623 | Clay with fine sand. | |
| | 6 | 47 39 | 125 53 | 780 | Greenish mud and fine sand. | |
| | 7 | 47 37 | 125 59 | 700 | Ooze and clay. | |
| | 8 | 47 32 | 126 14 | 1063 | Brown mud and ooze. | |
| | 9 | 47 25 | 126 28 | 1304 | Clay, mud, and ooze. | |
| Oct. 18–19 | 10 | 47 14 | 126 42 | 1387 | Light brown mud and ooze. | |
| Oct. 19 | 11 | 47 01 | 127 04 | 1385 | Blue clay and brown mud mixed, giving it variegated appearance. | |
| | 12 | 46 44 | 127 42 | 1492 | Ooze and brown mud. | |
| Oct. 20 | 13 | 46 14 | 128 48 | 1535 | Clay, brown mud, and ooze. | |
| | 14 | 45 18 | 128 57 | 1539 | Ooze. | Line 2. |
| Oct. 21 | 15 | 45 19 | 127 38 | 1576 | Brown ooze. | |
| | 16 | 45 10 | 126 35 | 1498 | Ooze. | |
| | 17 | 45 10 | 125 48 | 1578 | Clay. | |
| Oct. 22 | 18 | 44 57 | 125 29 | 1532 | Clay with specks of coarse black sand. | |
| | 19 | 44 54 | 125 13 | 834 | Fine gray sand with black specks. | |
| | 20 | 44 51 | 125 05 | 733 | Blue mud with fine black sand. | |
| | 21 | 44 53 | 125 01 | 525 | Hard clay with fine bl'k specks. | |
| | 22 | 44 52 | 124 55 | 294 | Clay. | |
| | 23 | 44 52 | 124 47 | 237 | Gray sand with black specks. | |
| | 24 | 44 51 | 124 40 | 206 | Gray sand with black specks. | |
| | 25 | 44 50 | 124 33 | 134 | Gray sand. | |
| | 26 | 44 49 | 124 28 | 97 | Mud and gray sand. | |
| Oct. 23 | 27 | 43 55 | 124 37 | 160 | Blue mud and sand. | Running down the coast. |
| | 28 | 43 25 | 124 32 | 61 | Dark sand. | Line 3. |
| | 29 | 43 26 | 124 41 | 140 | Dark sand. | |
| | 30 | 43 27 | 124 48 | 180 | No specimen. | Line parted in reeling in. |
| | 31 | 43 27 | 124 57 | 492 | Dark sand with black specks. | |
| | 32 | 43 27 | 125 06 | 716 | Dark sand with black specks. | |
| Oct. 24 | 33 | 43 08 | 125 23 | 1692 | Clay, mud, and specks of black sand. | |
| | 34 | 43 07 | 125 14 | 1270 | Clay and mud. | |
| | 35 | 43 10 | 125 46 | 1684 | No specimen. | |
| Oct. 25 | 36 | 43 12 | 127 00 | 1689 | Brown ooze with particles of sand. | |

SOUNDINGS OFF AND ON SHORE BETWEEN CAPE FLATTERY AND SAN FRANCISCO.

| Date. | No. of cast. | Latitude. | Longitude. | Depth in fms. | Nature of bottom. | Remarks. |
|---|---|---|---|---|---|---|
| 1873. | | N. ° ′ | W. ° ′ | | | |
| Oct. 25 | 37 | 43 24 | 128 10 | 1667 | Yellow-brown ooze. | |
| Oct. 26 | 38 | 41 54 | 128 59 | 1805 | Yellow-brown ooze. | Line 4. |
| Oct. 27 | 39 | 41 38 | 128 03 | 1707 | Brown ooze. | |
| | 40 | 41 30 | 127 11 | 996 | Rock, few particles of black sand came up. | |
| | 41 | 41 32 | 126 54 | 1689 | Clay ooze. | |
| Oct. 28 | 42 | 41 30 | 127 11 | 1721 | Greenish clay. | |
| | 43 | 41 29 | 127 27 | 1667 | Clay and brown ooze. | |
| | 44 | 41 16 | 127 12 | 1356 | Calcareous sand with black specks, and *Globergareya* and *Obulink* shells. | |
| | 45 | 41 07 | 127 10 | 1499 | Clay ooze. | |
| | 46 | 40 54 | 127 09 | 1521 | Greenish clay and ooze with particles of sand. | |
| | 47 | 40 56 | 126 27 | 1703 | Greenish-clay ooze. | |
| Oct. 29 | 48 | 41 03 | 125 38 | 1666 | Whitish-clay ooze; calcareous, with minute shells. | |
| | 49 | 41 03 | 125 16 | 1698 | Clay ooze. | |
| | 50 | 41 02 | 125 04 | 1666 | Clay ooze. | |
| | 51 | 41 01 | 124 48 | 966 | Clay ooze. | |
| | 52 | 41 00 | 124 35 | 358 | Clay ooze. | |
| | 53 | 41 00 | 124 27 | 261 | Whitish clay ooze with fine sand. | |
| | 54 | 41 01 | 124 19 | 66 | Clay, mud, fine sand. | |
| Oct. 30 | 55 | 40 16 | 124 30 | 601 | Hard gray sand. | |
| | 56 | 40 20 | 124 26 | 72 | Hard gray sand. | Line 5. |
| | 57 | 40 19 | 124 28 | 176 | Hard gray sand. | Bottom so hard that only few particles were brought up. |
| | 58 | 40 18 | 124 30 | 544 | Hard gray sand. | |
| | 59 | 40 19 | 124 32 | 731 | No specimen, but undoubtedly hard sand. | |
| | 60 | 40 21 | 124 41 | 766 | Gray sand. | |
| | 61 | 40 22 | 124 56 | 1166 | Hard gray sand. | |
| | 62 | 40 25 | 125 15 | 821 | Greenish mud and black sand. | |
| | 63 | 40 24 | 125 21 | 939 | Grayish-black sand. | |
| Oct. 31 | 64 | 40 11 | 125 44 | 1567 | Clay ooze. | |
| | 65 | 40 09 | 126 12 | 2263 | Clay and mud. | |
| Nov. 1 | 66 | 39 06 | 125 27 | 2006 | Clay ooze. | Line 6. |
| Nov. 2 | 67 | 39 05 | 125 14 | 1984 | Clay ooze. | |
| | 68 | 39 04 | 124 40 | 1832 | Clay ooze. | |
| | 69 | 39 02 | 124 09 | 423 | Black sand. | |
| | 70 | 39 00 | 124 00 | 127 | Black sand. | |
| Nov. 3 | 71 | 38 33 | 123 31 | 173 | Black sand. | Line 7. |
| | 72 | 38 32 | 123 24 | 81 | Black sand. | |
| | 73 | 38 31 | 123 41 | 520 | Black sand and mud. | |
| | 74 | 38 31 | 123 46 | 914 | Clay mud. | |
| | 75 | 38 32 | 123 53 | 1586 | Clay ooze. | |
| | 76 | 38 31 | 124 09 | 1821 | Clay ooze. | |
| Nov. 4 | 77 | 38 38 | 124 32 | 2115 | Clay ooze. | |
| | 78 | 38 37 | 125 28 | 2068 | Clay ooze. | |
| | 79 | 38 25 | 125 57 | 2308 | Gray and bluish ooze. | |
| Nov. 5 | 80 | 37 33 | 126 17 | 2443 | Brown and greenish ooze mixed. | Line 8. |
| | 81 | 37 34 | 125 25 | 2257 | Whitish-clay ooze. | |
| Nov. 6 | 82 | 37 40 | 123 36 | 1726 | Brown ooze. | |
| | 83 | 37 39 | 123 08 | 155 | Gray sand. | |

SOUNDINGS OFF AND ON SHORE BETWEEN SAN FRANCISCO AND SAN DIEGO.

| Date. | No. of cast. | Latitude. | Longitude. | Depth in fms. | Nature of bottom. | Remarks. |
|---|---|---|---|---|---|---|
| 1873. | | N. ° ′ | W. ° ′ | | | |
| Dec. 20 | 1 | 37 20 | 122 51 | 113 | Grayish-black sand. | Line 1. |
| | 2 | 37 18 | 122 54 | 181 | Grayish-black sand. | |
| | 3 | 37 15 | 122 59 | 358 | Grayish-black sand. | |
| | 4 | 37 12 | 123 05 | 673 | Hard black sand. | |
| | 5 | 37 04 | 123 22 | 1200 | Grayish-black sand and fine gravel. | |
| Dec. 21 | 6 | 36 48 | 124 03 | 2165 | Greenish mud. | |
| | 7 | 36 37 | 123 56 | 2104 | Greenish mud. | Line 2. |
| | 8 | 36 34 | 123 37 | 1940 | Greenish mud or ooze. | |
| | 9 | 36 32 | 123 11 | 1685 | Greenish mud. | |
| Dec. 22 | 10 | 36 27 | 122 54 | 1650 | Greenish mud. | |
| | 11 | 36 28 | 122 31 | 1170 | Greenish mud with black sand | |
| | 12 | 36 26 | 122 09 | 486 | Dark mud. | |
| | 13 | 36 25 | 122 04 | 190 | Grayish-black gravel. | |
| Dec. 24 | 14 | 36 13 | 121 50 | 207 | Greenish-black sand with shells. | Line 3. |
| | 15 | 36 10 | 121 56 | 686 | Very hard grayish-black sand. | |
| | 16 | 36 06 | 122 04 | 988 | Rock. | |
| | 17 | 36 02 | 122 12 | 882 | Hard grayish-black sand. | |
| Dec. 25 | 18 | 35 52 | 122 29 | 1814 | Greenish mud and sand. | |
| | 19 | 35 40 | 122 52 | 1995 | Greenish mud. | |
| | 20 | 35 28 | 122 44 | 1940 | Greenish ooze with particles of fine sand. | Line 4. |
| | 21 | 35 26 | 122 17 | 2044 | Greenish ooze. | |
| | 22 | 35 24 | 121 52 | 862 | Greenish mud with fine gray sand. | |
| Dec. 26 | 23 | 35 21 | 121 38 | 499 | Hard black sand. | |
| | 24 | 35 19 | 121 31 | 437 | Hard black sand. | |
| | 25 | 35 17 | 121 21 | 371 | Dark-greenish mud. | |
| | 26 | 35 15 | 121 12 | 289 | Dark-greenish mud. | |
| | 27 | 35 15 | 121 02 | 147 | Greenish mud. | |
| | 28 | 35 15 | 120 58 | 65 | Greenish mud. | |
| | 29 | 35 01 | 120 44 | 46 | Greenish mud with fine particles of sand. | Line 5. |
| | 30 | 34 59 | 120 47 | 80 | Clay mud. | |
| | 31 | 34 55 | 120 53 | 176 | Dark mud and sand. | |
| | 32 | 34 45 | 121 06 | 309 | Dark-greenish mud. | |
| | 33 | 34 36 | 121 16 | 490 | Grayish-black sand. | |
| Dec. 27 | 34 | 34 23 | 121 32 | 1995 | Dark-green mud. | |
| | 35 | 34 29 | 121 23 | 1198 | Green mud and sand. | |
| | 36 | 34 09 | 121 33 | 1988 | Greenish ooze. | Line 6. |
| | 37 | 34 03 | 121 14 | 1783 | Greenish mud. | |
| | 38 | 33 59 | 121 13 | 1467 | Hard black sand. | |
| Dec. 28 | 39 | 33 46 | 121 05 | 1674 | Greenish mud. | |
| | 40 | 33 41 | 120 50 | 1092 | Greenish sand, mud, and gravel. | |
| | 41 | 33 38 | 120 38 | 530 | Coarse gray sand. | |
| | 42 | 33 35 | 120 28 | 694 | Greenish mud. | |
| | 43 | 33 33 | 120 14 | 634 | No specimen. | |
| | 44 | 33 32 | 119 59 | 260 | Black sand. | |
| | 45 | 33 16 | 119 50 | 123 | Hard black sand. | Line 7. |
| Dec. 29 | 46 | 33 07 | 119 58 | 512 | Hard black sand. | |
| | 47 | 32 54 | 120 09 | 551 | Hard black sand. | |
| | 48 | 32 41 | 120 16 | 1833 | Yellow-brown mud. | |
| | 49 | 32 29 | 120 08 | 1052 | Grayish-black sand and gravel | Line 8. |
| | 50 | 32 29 | 119 52 | 844 | Yellowish-brown mud. | |
| | 51 | 32 28 | 119 32 | 769 | Gray sand. | |
| | 52 | 32 23 | 119 21 | 759 | Yellowish mud and sand. | |

SOUNDINGS OFF AND ON SHORE BETWEEN SAN FRANCISCO AND SAN DIEGO.

| Date. | No. of cast. | Latitude. | Longitude. | Depth in fms. | Nature of bottom. | Remarks. |
|---|---|---|---|---|---|---|
| 1873. | | N. ° ′ | W. ° ′ | | | |
| | 53 | 32 14 | 119 07 | 727 | Light-greenish mud with particles of sand. | |
| Dec. 30 | 54 | 32 15 | 118 51 | 695 | Gray and black sand. | |
| | 55 | 32 18 | 118 27 | 955 | Yellowish-brown mud. | |
| | 56 | 32 22 | 118 52 | 445 | Coarse gray sand with minute shells. | |
| | 57 | 32 22 | 117 44 | 784 | Yellowish-green mud. | |
| | 58 | 32 33 | 117 28 | 687 | Dark mud. | |

# TABLES OF SOUNDINGS

FOR

# SUBMARINE CABLE

BETWEEN

## CALIFORNIA AND JAPAN,

SOUTHERN ROUTE.

4

SOUNDINGS BETWEEN SAN DIEGO, CALIFORNIA, AND HONOLULU, HAWAIIAN ISLANDS.

| Date. | | No. of cast. | Latitude. | Longitude. | Depth in fms. | Nature of bottom. | Remarks. |
|---|---|---|---|---|---|---|---|
| 1874. | | | N. ° ′ | W. ° ′ | | | |
| Jan. | 6 | 1 | 32 31 | 117 20 | 71 | Gray and black sand and broken shells. | |
| | | 2 | 32 31 | 117 22 | 355 | Dark mud with fine sand. | |
| | | 3 | 32 30 | 117 24 | 622 | Dark mud with fine sand. | |
| | | 4 | 32 27 | 117 27 | 579 | Dark mud. | |
| | | 5 | 32 17 | 117 47 | 1053 | Greenish mud. | |
| Jan. | 7 | 6 | 32 04 | 118 12 | 203 | Rock. | Took a duplicate cast; obtained 328 fathoms sandy bottom; concluded it to be the cap of a submarine peak. |
| | | 7 | 32 00 | 118 26 | 595 | Gray sand with fine black specks. | |
| | | 8 | 31 56 | 118 41 | 566 | Gray sand with black specks. | |
| | | 9 | 31 51 | 119 03 | 980 | Whitish-green mud. | |
| | | 10 | 31 43 | 119 28 | 1915 | Yellowish-brown mud. | |
| Jan. | 8 | 11 | 31 25 | 120 04 | 2177 | Brown mud. | |
| | | 12 | 31 04 | 120 46 | 2178 | Brown mud. | |
| | | 13 | 30 52 | 121 37 | 2246 | Yellowish brown mud or ooze. | |
| Jan. | 9 | 14 | 30 39 | 122 28 | 2251 | Yellowish brown mud or ooze. | |
| | | 15 | 30 31 | 123 15 | 2103 | Yellowish brown mud or ooze. | |
| Jan. | 10 | 16 | 30 16 | 124 08 | 2363 | Yellowish-brown clay, very sticky. | |
| | | 17 | 29 55 | 125 12 | 2049 | Hard black sand. | |
| Jan. | 11 | 18 | 29 53 | 126 06 | 2199 | Yellowish-brown ooze. | |
| | | 19 | 29 39 | 126 59 | 2400 | Yellowish-brown ooze. | |
| Jan. | 12 | 20 | 29 15 | 128 05 | 2409 | Yellowish-brown ooze. | |
| | | 21 | 28 58 | 128 48 | 2517 | Yellowish-brown ooze. | |
| | | 22 | 28 42 | 129 34 | 2583 | Light-yellowish-brown mud. | |
| Jan. | 13 | 23 | 28 22 | 130 28 | 2587 | Yellowish-brown mud. | |
| Jan. | 14 | 24 | 28 19 | 131 19 | 2604 | Yellowish brown mud or ooze. | |
| | | 25 | 28 08 | 132 05 | 2356 | Yellowish brown ooze or mud. | |
| Jan. | 17 | 26 | 28 03 | 132 35 | 2323 | Yellowish-brown ooze. | |
| Jan. | 18 | 27 | 27 45 | 132 22 | 2540 | Yellowish brown mud or ooze. | |
| | | 28 | 27 30 | 134 11 | 2477 | Yellowish brown mud or ooze. | |
| Jan. | 19 | 29 | 27 10 | 131 58 | 2541 | Yellowish brown mud or ooze. | |
| | | 30 | 26 51 | 135 51 | 2440 | Yellowish brown mud or ooze. | |
| | | 31 | 26 36 | 136 38 | 2356 | Yellowish-brown mud. | |
| Jan. | 20 | 32 | 26 22 | 137 22 | 2159 | Whitish mud or ooze. | |
| | | 33 | 26 15 | 138 10 | 2650 | Yellowish-brown mud. | |
| Jan. | 21 | 31 | 26 09 | 139 00 | 2689 | Yellowish-brown mud. | |
| | | 35 | 25 59 | 139 45 | 2628 | Yellowish brown mud or ooze. | |
| Jan. | 22 | 36 | 25 52 | 140 40 | 2695 | Yellowish brown mud or ooze. | |
| | | 37 | 25 43 | 141 31 | 2553 | Yellowish brown mud or ooze. | |
| | | 38 | 25 36 | 142 14 | 2618 | Yellowish brown mud or ooze. | |
| Jan. | 25 | 39 | 25 21 | 142 29 | 2690 | Yellowish brown mud or ooze. | |
| | | 40 | 25 08 | 143 18 | 2631 | Yellowish brown mud or ooze. | |
| Jan. | 26 | 41 | 21 59 | 144 04 | 2811 | Yellowish brown mud or ooze. | |
| | | 42 | 24 49 | 144 52 | 2811 | Yellowish brown mud or ooze. | |
| Jan. | 27 | 43 | 24 40 | 145 35 | 2856 | Yellowish brown mud or ooze. | |
| | | 44 | 24 23 | 146 19 | 2962 | Yellow-brown mud or ooze. | |
| Jan. | 28 | 45 | 24 08 | 147 03 | 2922 | Yellow-brown mud or ooze. | |
| | | 46 | 23 51 | 147 47 | 2993 | Yellowish brown mud or ooze. | |
| Jan. | 29 | 47 | 23 38 | 148 42 | 2982 | Yellow-brown mud or ooze. | |
| | | 48 | 23 20 | 149 37 | 2936 | Yellow-brown mud or ooze. | |
| | | 49 | 23 10 | 150 31 | 3051 | Yellow-brown mud or ooze. | |
| Jan. | 30 | 50 | 23 01 | 151 26 | 3053 | Yellow-brown mud or ooze. | |
| | | 51 | 22 50 | 152 17 | 2953 | Yellow-brown mud. | |
| Jan | 31 | 52 | 22 40 | 153 17 | 2726 | Yellow-brown mud or ooze. | |
| | | 53 | 22 26 | 154 01 | 2562 | Yellow-brown mud with fine particles of sand. | |
| Feb. | 1 | 54 | 22 10 | 154 52 | 2488 | Yellow-brown mud. | |

| Date. | No. of cast. | Latitude. | Longitude. | Depth in fms. | Nature of bottom. | Remarks. |
|---|---|---|---|---|---|---|
| SOUNDINGS BETWEEN SAN DIEGO, CALIFORNIA, AND HONOLULU, HAWAIIAN ISLANDS. | | | | | | |
| 1874. | | N. ° ′ | W. ° ′ | | | |
| Feb. 1 | 55 | 21 55 | 155 39 | 2752 | Brown mud. | |
| | 56 | 21 43 | 156 21 | 3023 | Brown-mud ooze with fine particles of sand. | |
| Feb. 2 | 57 | 21 32 | 157 01 | 2086 | Brown mud with fine sand. | |
| | 58 | 21 26 | 157 19 | 498 | Yellowish-gray sand. | |
| | 59 | 21 24 | 157 26 | 403 | Whitish-gray sand. | |
| | 60 | 21 14 | 157 36 | 63 | White coral. | |
| | 61 | 21 12 | 157 42 | 272 | Whitish-gray sand. | |
| | 62 | 21 13 | 157 47 | 255 | Whitish-gray sand. | |
| SOUNDINGS BETWEEN HONOLULU, HAWAIIAN ISLANDS, AND PORT LLOYD, BONIN ISLANDS. | | | | | | |
| Mar. 17 | 1 | 21 10 | 158 04 | 206 | Gray sand with black specks and coral. | |
| | 2 | 21 07 | 158 14 | 1468 | Coarse whitish sand with pieces of lava the size of small pebbles. | |
| | 3 | 21 06 | 158 31 | 1580 | Coarse whitish sand. | |
| Mar. 18 | 4 | 21 00 | 159 25 | 2418 | Yellow-brown ooze. | |
| | 5 | 20 54 | 160 22 | 2565 | Yellow-brown ooze. | |
| Mar. 19 | 6 | 20 48 | 161 19 | 2555 | Yellow-brown ooze on rock. | |
| | 7 | 20 38 | 162 16 | 2495 | Rock. | |
| Mar. 20 | 8 | 20 25 | 163 25 | 2733 | Rock; black sand. | |
| | 9 | 20 18 | 164 27 | 2720 | Yellow-brown ooze. | |
| Mar. 21 | 10 | 20 13 | 165 31 | 2794 | Yellow-brown ooze. | |
| | 11 | 20 12 | 166 35 | 2803 | Yellow-brown ooze. | |
| Mar. 22 | 12 | 20 12 | 167 46 | 2460 | Rock. | |
| | 13 | 20 16 | 168 57 | 2737 | Yellow-brown ooze. | |
| Mar. 23 | 14 | 20 31 | 170 31 | 2421 | Yellow-brown ooze. | |
| | 15 | 20 41 | 171 33 | 1874 | White coral with lumps of lava | |
| Mar. 24 | 16 | 20 52 | 172 39 | 3045 | No specimen. | Wire broke in reeling in. |
| | 17 | 21 04 | 173 54 | 2952 | Yellow-brown ooze. | |
| Mar. 25 | 18 | 21 21 | 174 57 | 2993 | Yellow-brown ooze. | |
| | 19 | 21 27 | 176 03 | 3106 | Yellow-brown mud or ooze. | |
| Mar. 26 | 20 | 21 21 | 177 10 | 3100 | Yellow-brown ooze. | |
| | 21 | 21 29 | 178 15 | 2828 | Yellow-brown ooze. | |
| Mar. 27 | 22 | 21 38 | 179 27 | 2725 | Light yellow-brown ooze. | |
| | | N. | E. | | | |
| Mar. 29 | 23 | 21 40 | 179 20 | 1964 | Whitish cream-colored ooze. | |
| | 24 | 21 41 | 178 04 | 1625 | Coral mud. | |
| Mar. 30 | 25 | 21 41 | 176 50 | 1108 | White coral. | |
| | 26 | 21 47 | 175 44 | 1817 | White coral. | |
| Mar. 31 | 27 | 21 56 | 174 44 | 1613 | White coral and sand. | |
| | 28 | 22 01 | 173 43 | 2813 | Light yellow-brown ooze. | |
| April 1 | 29 | 22 05 | 172 41 | 2836 | Yellow-brown mud with piece of lava. | |
| | 30 | 22 09 | 171 32 | 2771 | Yellow-brown mud. | |
| April 2 | 31 | 22 20 | 170 31 | 3090 | Yellow-brown ooze; grains of sand. | |
| | 32 | 22 29 | 169 28 | 3211 | Yellow-brown ooze. | |
| April 3 | 33 | 22 44 | 168 23 | 3262 | Dark yellow-brown mud. | |
| | 34 | 22 51 | 167 21 | 3232 | Yellow-brown mud. | |
| April 4 | 35 | 22 59 | 166 13 | 3155 | Yellow-brown mud. | |
| | 36 | 23 05 | 165 13 | 3185 | Yellow-brown mud. | |
| April 5 | 37 | 23 09 | 164 03 | 3148 | Yellow-brown mud. | |
| | 38 | 23 17 | 162 58 | 2870 | Yellow-brown mud. | |

SOUNDINGS BETWEEN HONOLULU, HAWAIIAN ISLANDS, AND PORT LLOYD, BONIN ISLANDS.

| Date. | No. of cast. | Latitude. | Longitude. | Depth in fms. | Nature of bottom. | Remarks. |
|---|---|---|---|---|---|---|
| 1874. | | N. ° ′ | E. ° ′ | | | |
| April 6 | 39 | 23 31 | 161 51 | 3009 | Yellow-brown mud. | |
| | 40 | 23 45 | 160 56 | 1400 | Coral limestone and sand. | |
| April 7 | 41 | 24 07 | 160 09 | 3023 | Yellow-brown mud. | |
| | 42 | 24 19 | 159 21 | 2938 | Yellow-brown mud; lump of lava. | |
| April 8 | 43 | 23 55 | 158 07 | 2042 | Coral limestone with sand. | |
| April 9 | 44 | 23 46 | 157 12 | 2173 | Coral limestone with sand. | |
| | 45 | 23 56 | 156 10 | 3075 | Yellow-brown ooze. | |
| April 10 | 46 | 24 02 | 155 08 | 3273 | Yellow-brown mud. | |
| | 47 | 24 20 | 154 06 | 1499 | Coral limestone with specks of lava. | |
| April 11 | 48 | 24 25 | 152 01 | 2956 | No specimen. | Wire broke. |
| | 49 | 24 41 | 151 46 | 3023 | Yellow-brown ooze. | |
| April 12 | 50 | 24 46 | 150 51 | 3061 | Yellow-brown ooze. | |
| | 51 | 25 11 | 149 46 | 3287 | No specimen. | Cylinder came up battered. Must have struck rock. |
| April 13 | 52 | 25 42 | 148 39 | 1712 | Coral limestone with particles of sand. | |
| | 53 | 25 55 | 147 47 | 2534 | Yellow-brown ooze with hard lumps of clay. | |
| April 14 | 54 | 26 09 | 146 10 | 3018 | Yellow-brown ooze with particles of black sand. | |
| | 55 | 26 18 | 144 54 | 1700 | Coral limestone with particles of lava. | |
| April 15 | 56 | 26 28 | 143 33 | 2080 | Gray sand with black specks. | |
| | 57 | 26 41 | 142 42 | 1331 | Coral limestone with specks of lava. | Coffin and Peel Islands in sight. |
| | 58 | 26 52 | 142 21 | 814 | Gray sand with specks of coral and lava. | |
| | 59 | 26 55 | 142 14 | 487 | Coral limestone. | |

SOUNDINGS BETWEEN PORT LLOYD, BONIN ISLANDS, AND YOKOHAMA, JAPAN.

| Date. | No. of cast. | Latitude. | Longitude. | Depth in fms. | Nature of bottom. | Remarks. |
|---|---|---|---|---|---|---|
| April 18 | 1 | 27 07 | 142 07 | 73 | Coral and broken shells. | |
| | 2 | 27 16 | 141 56 | 108 | Lava, coral, small and broken shells. | |
| | 3 | 27 47 | 141 50 | 345 | Coral limestone with specks of lava. | |
| | 4 | 28 09 | 141 42 | 869 | Coral limestone with lumps of lava. | |
| April 19 | 5 | 28 56 | 141 50 | 1344 | Coral limestone with lumps of lava and broken shells. | |
| | 6 | 29 56 | 141 52 | 2435 | Slaty-brown mud, with particles of lava, sand, and broken shells. | |
| April 20 | 7 | 30 29 | 141 04 | 1669 | Lumps and particles of lava with brown mud. | |
| | 8 | 31 18 | 140 53 | 1382 | Hard with fine particles of lava. | |
| April 21 | 9 | 32 13 | 140 37 | 1135 | Blue mud with coarse sand. | |
| | 10 | 32 58 | 140 22 | 566 | Lava; small specimen. | Cylinder came up, battered on point. |
| | 11 | 33 46 | 140 21 | 437 | Coral and broken shells. | |
| April 22 | 12 | 34 31 | 140 14 | 1618 | Blue mud with lava. | |
| | 13 | 34 45 | 140 01 | 595 | Grayish-black sand. | No Sima light bearing (p.c.) NW. by N., distant 10 ms. |
| | 14 | 34 53 | 139 46 | 35 | Broken shells. | |

# TABLES OF SOUNDINGS

FOR

# SUBMARINE CABLE

BETWEEN

## CALIFORNIA AND JAPAN,

NORTHERN ROUTE.

SOUNDINGS BETWEEN YOKOHAMA, JAPAN, AND TANAGA ISLAND, ALEUTIAN GROUP.

| Date. | No. of cast. | Latitude. | Longitude. | Depth in fms. | Nature of bottom. | Remarks. |
|---|---|---|---|---|---|---|
| | | N. ° ′ | E. ° ′ | | | |
| June 9 | 1 | 34 58 | 140 03 | 50 | Grayish-black sand; shells. | |
| | 2 | 35 04 | 140 15 | 235 | Grayish-black sand. | |
| | 3 | 35 10 | 140 27 | 33 | Grayish-black sand and broken shells. | |
| | 4 | 35 18 | 140 36 | 19 | Grayish-black sand and broken shells. | |
| | 5 | 35 26 | 140 44 | 25 | Grayish-black sand with broken shells. | |
| | 6 | 35 33 | 140 53 | 15 | Grayish-black sand with broken shells. | |
| | 7 | 35 44 | 141 06 | 72 | Grayish-black sand. | |
| | 8 | 35 52 | 141 22 | 580 | Grayish-black sand with gray mud. | |
| June 10 | 9 | 36 13 | 141 34 | 871 | Dark mud with grains of sand. | |
| | 10 | 36 33 | 141 58 | 1358 | Clay-colored mud with fine particles of sand. | |
| | 11 | 36 58 | 142 15 | 1425 | Clay-colored mud with particles of sand. | |
| | 12 | 37 19 | 142 42 | 1274 | Clay-colored mud with fine particles of sand. | |
| June 11 | 13 | 37 37 | 143 09 | 1833 | Clay-colored ooze. | |
| | 14 | 37 54 | 143 40 | 3127 | Clay mud. | |
| | 15 | 38 11 | 144 33 | 4643 | No specimen. | Wire broke. Bottom not reached. |
| June 13 | 16 | 38 13 | 142 09 | 411 | Grayish-black sand. | Not on profile. |
| | 17 | 38 34 | 142 30 | 1358 | Gray-black sand. | |
| | 18 | 39 09 | 142 33 | 1153 | Gray sand and mud. | |
| June 14 | 19 | 39 36 | 142 41 | 1017 | Clay-colored mud. | |
| | 20 | 40 10 | 142 57 | 653 | Grayish-black sand with fine gravel. | |
| | 21 | 40 39 | 143 25 | 1137 | Clay-colored mud, sand, and gravel. | |
| | 22 | 41 09 | 144 01 | 2266 | Grayish-black sand. | |
| June 15 | 23 | 41 25 | 144 47 | 2856 | Clay-colored mud. | |
| | 24 | 41 46 | 145 40 | 3439 | Hard yellow sand with black specks. | |
| June 16 | 25 | 41 53 | 146 08 | 3587 | Yellowish and clay-colored mud with coarse sand. | |
| | 26 | 42 08 | 146 50 | 3507 | Yellow and clay-colored mud with specks of lava. | |
| June 17 | 27 | 42 34 | 147 38 | 4340 | Yellow and clay-brown mud. | |
| | 28 | 42 57 | 148 23 | 4356 | Yellowish mud and sand with specks of lava. | |
| June 18 | 29 | 43 21 | 149 12 | 4041 | Yellow and clay-colored mud and gravel. | |
| | 30 | 43 47 | 150 02 | 4231 | Rocky. | Point of cylinder came up battered. |
| | 31 | 44 10 | 150 50 | 4120 | Yellow and clay-colored mud mixed. | |
| | 32 | 44 28 | 151 37 | 4411 | No specimen. | Wire broke. |
| June 19 | 33 | 44 55 | 152 26 | 4655 | No specimen. | Wire broke. |
| June 20 | 34 | 46 21 | 151 25 | 1445 | Grayish-black sand and fine gravel. | |
| | 35 | 46 00 | 150 45 | 881 | Grayish-black sand and fine gravel. | |
| June 21 | 36 | 45 35 | 150 12 | 317 | Grayish-black sand and gravel | |
| | 37 | 45 07 | 149 46 | 332 | Gray sand and gravel. | |
| | 38 | 44 44 | 149 23 | 944 | Hard; no specimen came up. | |
| | 39 | 44 23 | 148 53 | 1246 | Grayish-black sand. | |

SOUNDINGS BETWEEN YOKOHAMA, JAPAN, AND TANAGA ISLAND, ALEUTIAN GROUP.

| Date. | No. of cast. | Latitude. | Longitude. | Depth in fms. | Nature of bottom. | Remarks. |
|---|---|---|---|---|---|---|
| 1874. | | N. ° ′ | E. ° ′ | | | |
| June 22 | 40 | 44 02 | 148 16 | 1050 | Grayish-black sand. | |
| | 41 | 43 42 | 147 44 | 1103 | Clay-colored mud with fine particles of sand. | |
| | 42 | 43 20 | 147 04 | 1048 | Clay-colored mud with gray sand. | |
| | 43 | 42 59 | 146 25 | 1329 | Hard clay and mud. | |
| June 23 | 44 | 42 36 | 145 49 | 1379 | Grayish-black sand. | |
| | 45 | 42 15 | 145 09 | 1619 | Clay-colored mud and sand. | |
| | 46 | 41 54 | 144 35 | 1108 | Grayish-black sand; gravel. | |
| | 47 | 41 32 | 144 18 | 1582 | Clay-colored mud. | |
| July 4 | 48 | 46 38 | 151 47 | 702 | Coarse grayish-black sand. | |
| | 49 | 46 56 | 152 19 | 490 | Coarse grayish-black sand. | |
| | 50 | 47 11 | 152 54 | 1134 | Gray sand with specks of lava. | |
| | 51 | 47 30 | 153 33 | 1594 | Gray sand. | |
| | 52 | 47 44 | 154 15 | 1040 | Grayish-black sand. | |
| July 5 | 53 | 48 01 | 154 51 | 1371 | Grayish-black sand with gravel and clay-colored ooze. | |
| | 54 | 48 21 | 155 28 | 1919 | Grayish-black sand with gravel and pebbles and clay-colored ooze. | |
| | 55 | 48 40 | 156 07 | 2631 | Whitish ooze with sand. | |
| July 6 | 56 | 48 59 | 156 42 | 3039 | Whitish ooze with sand. | |
| | 57 | 49 23 | 157 21 | 3119 | Clay mud. | |
| July 7 | 58 | 49 41 | 157 58 | 2797 | Clay-colored mud with fine sand. | |
| | 59 | 50 02 | 158 49 | 3274 | Clay-colored ooze. | |
| | 60 | 50 22 | 159 40 | 3754 | Clay-colored ooze. | |
| July 10 | 61 | 51 06 | 161 08 | 2970 | Clay-colored mud with fine sand. | |
| | 62 | 51 22 | 162 20 | 2934 | Clay-colored mud. | |
| July 11 | 63 | 51 31 | 163 23 | 2981 | Yellowish mud with lumps of hard clay, and particles of fine black sand. | |
| | 64 | 51 39 | 164 30 | 2720 | Yellowish ooze with fine black mud. | |
| | 65 | 51 43 | 165 25 | 2793 | Yellowish ooze with fine particles of black sand. | |
| | 66 | 51 47 | 166 26 | 1896 | Clay with particles of sand. | |
| July 12 | 67 | 51 50 | 167 22 | 1777 | Yellowish mud with fine sand. | |
| | 68 | 51 52 | 168 10 | 2005 | Yellowish clay or mud with fine sand. | |
| | 69 | 51 55 | 169 00 | 2320 | Yellowish mud with fine particles of sand. | |
| | 70 | 51 58 | 169 42 | 2711 | Yellowish mud with sand and lumps of lava. | |
| July 13 | 71 | 52 01 | 170 28 | 2463 | Yellowish mud. | |
| | 72 | 52 04 | 171 15 | 4037 | Yellowish ooze. | |
| | 73 | 52 09 | 172 02 | 2463 | Clay with gravel and fine sand. | |
| July 14 | 74 | 52 11 | 172 41 | 1857 | Clay-colored mud with black sand and fine gravel. | |
| | 75 | 52 14 | 173 14 | 947 | Clay-colored mud with fragments of lava and fine sand. | |
| | 76 | 52 05 | 174 01 | 1668 | Clay-colored mud with sand. | |
| | 77 | 51 58 | 174 31 | 332 | Grayish-black sand. | |
| | 78 | 51 50 | 175 09 | 303 | Grayish-black sand. | |
| July 15 | 79 | 51 40 | 175 55 | 799 | Grayish-black sand. | |
| | 80 | 51 33 | 176 31 | 998 | Grayish-black sand. | |
| | 81 | 51 30 | 177 14 | 1014 | Grayish-black sand. | |

SOUNDINGS BETWEEN YOKOHAMA, JAPAN, AND TANAGA ISLAND, ALEUTIAN GROUP.

| Date. | No. of cast. | Latitude. | Longitude. | Depth in fms. | Nature of bottom. | Remarks. |
|---|---|---|---|---|---|---|
| 1874. | | N. ° ′ | E. ° ′ | | | |
| July 15 | 82 | 51 25 | 177 55 | 565 | Grayish-black sand. | |
| | 83 | 51 23 | 178 19 | 282 | Black sand with gravel. | Not on profile. |
| July 16 | 84 | 51 22 | 178 29 | 208 | Grayish-black sand. | Not on profile. |
| | 85 | 51 12 | 178 20 | 1313 | Grayish-black sand and lumps of clay. | Not on profile. |
| | 86 | 51 15 | 178 35 | 548 | Gray-black sand. | |
| | 87 | 51 10 | 178 58 | 237 | Gray-black sand and gravel. | |
| | 88 | 51 05 | 179 23 | 975 | Gray-black sand. | |
| | 89 | 51 05 | 179 41 | 1358 | Gray-black sand. | |
| | | N. | W. | | | |
| | 90 | 51 14 | 179 39 | 1131 | Grayish-black sand. | Not on profile. |
| | 91 | 51 01 | 179 14 | 1838 | Clay-colored mud with grayish-black sand. | |
| | 92 | 51 08 | 178 35 | 1779 | Clay-colored mud with grayish black sand and sponges. | |
| | 93 | 51 15 | 178 01 | 1034 | Clay-colored mud with grayish-black sand. | Not on profile. |
| July 17 | 94 | 51 28 | 177 59 | 233 | Rocky, with grayish-black sand and pebbles. | Not on profile; cylinder came up very much battered. |
| July 19 | 95 | 51 35 | 178 13 | 45 | Broken shells and pebbles. | |
| | 96 | 51 44 | 178 10 | 53 | Black sand. | |
| July 25 | 97 | 51 47 | 178 12 | 44 | Rocky. | Not on profile. |

SOUNDINGS BETWEEN TANAGA, ALEUTIAN ISLANDS, AND CAPE FLATTERY.

| Date. | No. of cast. | Latitude. | Longitude. | Depth in fms. | Nature of bottom. | Remarks. |
|---|---|---|---|---|---|---|
| July 25 | 98 | 51 51 | 178 36 | 995 | Clay-colored mud and black sand. | Not on profile. |
| | 99 | 51 57 | 178 27 | 993 | Black sand and gravel. | |
| | 100 | 52 02 | 178 07 | 1055 | Black sand. | |
| | 101 | 52 06 | 177 28 | 1339 | Black sand. | |
| July 26 | 102 | 52 11 | 176 48 | 1681 | Clay-colored mud with fine black sand. | |
| | 103 | 52 18 | 176 01 | 1681 | Clay-colored mud with dark sand and fine gravel. | |
| | 104 | 52 25 | 175 18 | 1755 | Clay-colored mud with fine gray sand. | |
| | 105 | 52 32 | 174 27 | 1548 | Clay-colored mud with fine gray sand. | |
| July 27 | 106 | 52 39 | 173 51 | 1257 | Clay-colored mud with hard lumps of clay and black sand. | |
| | 107 | 52 47 | 173 04 | 1029 | Clay-colored mud with black sand and gravel. | |
| | 108 | 52 58 | 172 11 | 928 | Clay-colored mud, black sand and gray gravel. | |
| | 109 | 53 08 | 171 19 | 1006 | Grayish-bl'k sand and broken shells. | |
| July 28 | 110 | 53 17 | 170 23 | 1032 | Clay-colored mud with gray-black sand. | |
| | 111 | 53 57 | 169 28 | 1158 | Clay mud with fine gray sand. | Not on profile. |
| | 112 | 53 40 | 169 01 | 770 | Clay-colored mud with fine gray-black sand. | |
| | 113 | 53 57 | 168 08 | 1169 | Clay-colored mud with gray-black sand. | |
| July 29 | 114 | 54 06 | 168 31 | 1212 | Clay mud with black specks. | Not on profile. |
| | 115 | 54 13 | 167 57 | 812 | Clay-colored mud with fine sand. | Not on profile. |

SOUNDINGS BETWEEN TANAGA, ALEUTIAN ISLANDS, AND CAPE FLATTERY.

| Date. | No. of cast. | Latitude. | Longitude. | Depth in fms. | Nature of bottom. | Remarks. |
|---|---|---|---|---|---|---|
| 1874. | | N. ° ′ | W. ° ′ | | | |
| July 29 | 116 | 54 11 | 167 18 | 959 | Clay-colored mud with fine sand. | |
| | 117 | 54 06 | 166 54 | 658 | Clay-colored mud and black sand. | |
| Aug. 7 | 118 | 54 14 | 166 17 | 602 | Clay-colored mud, black sand, and gravel. | |
| | 119 | 54 23 | 165 40 | 231 | Black sand and gravel. | |
| | 120 | 54 20 | 165 05 | 89 | Black sand. | |
| | 121 | 54 17 | 164 41 | 33 | Fine black gravel. | |
| Aug. 8 | 122 | 54 09 | 163 54 | 46 | Black sand and gravel. | |
| | 123 | 54 09 | 163 17 | 42 | Coarse gray-black sand. | |
| | 124 | 54 10 | 162 39 | 44 | Coarse gravel and broken shells | |
| | 125 | 54 11 | 162 10 | 360 | Clay-colored mud with gray-black sand. | |
| Aug. 9 | 126 | 54 08 | 161 31 | 500 | Hard clay. | |
| | 127 | 54 05 | 160 44 | 1365 | Clay-colored mud with lumps and sand. | |
| | 128 | 54 03 | 159 58 | 1500 | Clay-colored mud with particles of sand. | |
| Aug. 10 | 129 | 54 01 | 159 10 | 1925 | Clay with fine particles of sand | |
| | 130 | 54 00 | 158 22 | 3359 | Hard. | No specimen; cylinder bruised. |
| | 131 | 54 00 | 157 27 | 3130 | Hard clay. | |
| | 132 | 53 59 | 156 33 | 2814 | Clay. | |
| Aug. 11 | 133 | 53 54 | 155 38 | 2525 | Clay mud. | |
| | 134 | 53 58 | 154 44 | 2459 | Clay mud. | |
| | 135 | 54 02 | 153 50 | 2520 | Clay mud. | |
| Aug. 12 | 136 | 54 21 | 155 07 | 2843 | Clay mud. | |
| Aug. 13 | 137 | 54 21 | 156 21 | 2910 | Clay | |
| | 138 | 54 27 | 158 08 | 1148 | Clay-colored mud, black sand, and gravel. | |
| Aug. 14 | 139 | 54 11 | 159 04 | 1263 | Clay mud. | |
| | 140 | 53 46 | 161 25 | 2149 | Clay mud. | |
| Aug. 15 | 141 | 53 38 | 162 31 | 1955 | Clay mud. | |
| | 142 | 53 33 | 163 20 | 1540 | Clay mud. | |
| | 143 | 53 30 | 164 08 | 1555 | Clay mud. | |
| | 144 | 53 33 | 164 51 | 827 | Clay mud with fine gravel and lava. | |
| | 145 | 53 40 | 165 15 | 145 | Gray-black sand. | |
| Aug. 16 | 146 | 53 57 | 165 25 | 54 | Black sand. | |
| | 147 | 54 00 | 165 46 | 53 | . . . . . . . . . . . . . | No specimen. |
| | 148 | (*) | (*) | 64 | . . . . . . . . . . . . . | No specimen. |
| | 149 | (†) | (†) | 38 | . . . . . . . . . . . . . | No specimen. |
| | 150 | (†) | (†) | 35 | . . . . . . . . . . . . . | No specimen. |
| | 151 | (†) | (†) | 18 | . . . . . . . . . . . . . | No specimen. |
| | 152 | 54 03 | 166 03 | 27 | . . . . . . . . . . . . . | No specimen. |
| Aug. 17 | 153 | 54 05 | 163 34 | 55 | Grayish-black sand. | |
| | 154 | 53 53 | 163 14 | 592 | Clay-colored mud, black sand, and pebbles. | |
| Aug. 18 | 155 | 53 44 | 162 20 | 1327 | Grayish sand. | |
| | 156 | 53 37 | 161 32 | 2506 | Clay mud. | |
| Aug. 19 | 157 | 53 35 | 160 00 | 3664 | Clay mud. | |
| | 158 | 53 31 | 158 57 | 2854 | Clay mud. | |
| | 159 | 53 22 | 157 45 | 2587 | Clay mud. | |
| Aug. 20 | 160 | 53 16 | 156 37 | 2482 | Clay mud and fine dark sand. | |
| | 161 | 53 06 | 155 13 | 2419 | Clay mud with fine sand. | |
| Aug. 21 | 162 | 52 36 | 153 39 | 2513 | Clay mud with particles of fine sand. | |

* One mile west of Akoutan Pass. † Akoutan Pass.

SOUNDINGS BETWEEN TANAGA, ALEUTIAN ISLANDS, AND CAPE FLATTERY.

| Date. | No. of cast. | Latitude. | Longitude. | Depth in fms. | Nature of bottom. | Remarks. |
|---|---|---|---|---|---|---|
| 1873. | | N. ° ′ | W. ° ′ | | | |
| Sept. 30 | 34 | 53 58 | 153 00 | 2534 | Ooze with fine black sand. | |
| Sept. 29 | 33 | 53 51 | 151 19 | 2492 | Ooze with coarse black gravel and sand. | |
| | 32 | 53 55 | 150 01 | 2267 | Ooze mixed with fine sand. | |
| Sept. 28 | 31 | 53 45 | 149 03 | 2337 | Ooze and shingle. | |
| Sept. 27 | 30 | 53 33 | 147 27 | 2299 | Ooze with fine gravel. | |
| | 29 | 53 27 | 146 13 | 2292 | Ooze with black gravel and shingle. | |
| Sept. 26 | 28 | 53 17 | 145 06 | 2243 | Ooze with black sand and gravel. | |
| | 27 | 53 02 | 143 55 | 2158 | Oooze with black sand and fine gravel. | |
| | 26 | 52 59 | 142 37 | 2117 | Ooze. | |
| Sept. 25 | 25 | 52 37 | 141 18 | 2074 | Ooze. | |
| | 24 | 52 13 | 139 55 | 2032 | Brown ooze. | |
| Sept. 24 | 23 | 52 02 | 138 44 | 1995 | Ooze and brown mud. | |
| | 22 | 51 40 | 137 32 | 2031 | Ooze and brown mud. | |
| Sept. 23 | 21 | 51 28 | 135 54 | 2030 | Clay, ooze. | |
| Sept. 22 | 20 | 51 03 | 134 41 | 1933 | Clay. | |
| | 19 | 50 59 | 133 41 | 1828 | Clay. | |
| Sept. 21 | 18 | 50 45 | 132 39 | 1626 | Clay ooze. | |
| | 17 | 50 36 | 131 47 | 1611 | Ooze. | |
| | 16 | 50 25 | 131 03 | 1579 | Ooze. | |
| Sept. 20 | 15 | 50 06 | 129 57 | 1452 | Sand and gravel. | |
| | 14 | 49 46 | 129 27 | 1007 | Sand and mud. | |
| | 13 | 49 26 | 128 37 | 1316 | Blue mud. | |
| Sept. 19 | 12 | 49 26 | 128 37 | . . | . . . . . . . . . . . . | Duplicate cast of 12 not obtained. |
| | 11 | 49 16 | 128 14 | 1318 | Clay and mud. | |
| Sept. 18 | 10 | 49 12 | 127 24 | 900 | Blue clay and mud. | |
| | 9 | 49 12 | 127 10 | 618 | Clay. | |
| | 8 | 49 10 | 127 00 | 554 | Sandy. | |
| Sept. 17 | 7 | 49 06 | 126 56 | 399 | Sandy. | |
| | 6 | 49 02 | 126 46 | 292 | Clay. | |
| | 5 | 48 53 | 126 20 | 88 | Sand. | |
| | 4 | 48 47 | 126 02 | 55 | Sand. | |
| | 3 | 48 41 | 125 42 | 42 | Coarse gravel. | |
| | 2 | 48 35 | 125 25 | 47 | No specimens except a few particles of fine black sand. | |
| | 1 | 48 33 | 125 11 | 55 | Gray black sand. | |

# SERIAL TEMPERATURES

OF THE

# NORTH PACIFIC OCEAN

AND

# BEHRING SEA,

OBTAINED IN THE

UNITED STATES STEAMSHIP TUSCARORA (THIRD RATE),

Commander G. E. BELKNAP, Commanding.

SERIAL TEMPERATURES OBTAINED ON

| Date. | No. of cast. | Position. Lat. | Position. Long. | Surface-temperature. | TEMPERATURES AT DEPTHS OF— Fms. 10 | Fms. 20 | Fms. 30 | Fms. 40 | Fms. 50 | Fms. 60 | Fms. 70 | Fms. 80 | Fms. 90 | Fms. 100 | Fms. 130 | Fms. 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1873. | | N. ° ′ | W. ° ′ | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° |
| Aug. 13 | 2 | 37 28 | 123 13 | 59.4 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 3 | 37 27 | 123 21 | 59.3 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 4 | 27 25 | 123 26 | 59.1 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 6 | 37 27 | 123 33 | 59.0 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |

SERIAL TEMPERATURES OBTAINED ON LINES OF SOUNDINGS OFF AND

| Date. | No. of cast. | Lat. | Long. | Surface-temperature. | Fms. 10 | Fms. 20 | Fms. 30 | Fms. 40 | Fms. 50 | Fms. 60 | Fms. 70 | Fms. 80 | Fms. 90 | Fms. 100 | Fms. 130 | Fms. 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1873. | | N. ° ′ | W. ° ′ | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° |
| Oct. 18 | 10 | 47 14 | 126 42 | 57.0 | . . | . . | 50.0 | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| Oct. 19 | 11 | 47 01 | 127 04 | 57.1 | . . | . . | . . | . . | . . | . . | . . | . . | . . | 44.2 | . . | . . |
| | 12 | 46 44 | 127 42 | 57.2 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| Oct. 20 | 13 | 46 14 | 128 48 | 58.5 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 14 | 45 18 | 128 57 | 59.5 | . . | 55.2 | 54.2 | 47.7 | 45.6 | . . | . . | . . | . . | 44.2 | . . | 42.9 |
| Oct. 21 | 15 | 45 19 | 127 38 | 59.0 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 16 | 45 10 | 126 35 | 57.0 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| Oct. 22 | 18 | 44 57 | 125 29 | 53.3 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 19 | 44 51 | 125 13 | 52.3 | . . | . . | . . | . . | . . | . . | . . | . . | . . | 45.1 | . . | . . |
| | 22 | 44 52 | 124 55 | 51.2 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 23 | 44 52 | 124 47 | 50.4 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| Oct. 24 | 31 | 43 07 | 125 14 | 53.2 | 52.4 | 48.7 | 46.1 | 45.5 | 45.4 | . . | . . | . . | . . | 43.8 | . . | . . |
| | 35 | 43 10 | 125 46 | 52.1 | 50.4 | 50.6 | 45.5 | 44.4 | . . | 44.5 | . . | 41.3 | . . | 44.4 | . . | 42.4 |
| Oct. 25 | 36 | 43 12 | 127 00 | 54.9 | 53.2 | 53.6 | 50.8 | 45.4 | 45.2 | 45.2 | . . | 45.1 | . . | 44.6 | . . | . . |
| | 37 | 43 24 | 128 10 | 57.6 | 55.4 | 54.3 | 53.6 | . . | 45.8 | . . | . . | . . | . . | 44.7 | . . | 43.7 |
| Oct. 26 | 38 | 41 54 | 128 59 | 54.8 | 54.0 | 52.9 | 48.3 | 47.3 | 46.3 | . . | . . | . . | . . | 45.2 | . . | 43.6 |
| Oct. 27 | 39 | 41 38 | 128 03 | 58.1 | . . | 56.2 | . . | 49.7 | . . | 47.6 | . . | 46.2 | . . | 45.0 | . . | 43.6 |
| | 40 | 41 30 | 127 11 | 54.8 | 52.1 | . . | . . | . . | 46.7 | . . | . . | . . | . . | 44.4 | . . | . . |
| | 41 | 41 32 | 126 54 | 53.3 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| Oct. 28 | 44 | 41 16 | 127 12 | 53.0 | . . | 52.3 | . . | . . | 46.0 | . . | . . | 44.8 | . . | 44.0 | . . | . . |
| | 45 | 41 07 | 127 10 | 54.6 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 47 | 40 56 | 126 27 | 51.0 | . . | . . | 49.5 | . . | 47.7 | . . | . . | . . | . . | 44.5 | . . | 42.9 |
| Oct. 29 | 48 | 41 03 | 125 38 | 52.0 | 51.0 | 49.0 | 47.2 | 47.0 | 45.7 | . . | . . | . . | . . | 44.4 | . . | . . |
| | 49 | 41 03 | 125 16 | 50.2 | 49.6 | 49.3 | 48.3 | . . | 47.3 | . . | . . | 46.2 | . . | 45.1 | . . | 43.6 |
| | 50 | 41 02 | 125 04 | 50.0 | . . | . . | 47.7 | . . | 46.6 | . . | . . | . . | . . | 44.9 | . . | . . |
| | 51 | 41 01 | 124 48 | 49.4 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 52 | 41 00 | 124 35 | 49.0 | . . | . . | . . | . . | 46.7 | . . | . . | . . | . . | 44.4 | . . | . . |
| | 53 | 41 00 | 124 27 | 48.5 | . . | . . | 47.3 | . . | . . | 46.3 | . . | . . | . . | . . | . . | . . |
| Oct. 30 | 58 | 40 18 | 124 30 | 49.6 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 59 | 40 19 | 124 32 | 50.6 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 61 | 40 22 | 124 56 | 55.6 | . . | . . | 46.4 | . . | 45.0 | . . | . . | . . | . . | 43.6 | . . | . . |
| | 62 | 40 25 | 125 15 | 51.2 | . . | . . | . . | 48.0 | . . | . . | . . | . . | . . | . . | . . | . . |
| Oct. 31 | 64 | 40 11 | 125 44 | 53.2 | . . | . . | . . | . . | 45.2 | . . | . . | 44.9 | . . | 43.8 | . . | 41.9 |
| | 65 | 40 09 | 126 12 | 55.0 | . . | . . | . . | . . | 48.4 | . . | . . | . . | . . | 44.4 | . . | . . |
| Nov. 1 | 66 | 39 06 | 125 27 | 55.8 | 54.3 | 54.3 | 49.7 | 48.0 | 46.8 | . . | . . | . . | . . | 44.8 | . . | . . |
| Nov. 2 | 67 | 39 05 | 125 14 | 53.1 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 68 | 39 04 | 124 40 | 52.8 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| Nov. 3 | 74 | 38 31 | 123 46 | 51.7 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 75 | 38 32 | 123 53 | 52.8 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| Nov. 4 | 78 | 38 37 | 125 28 | 57.9 | . . | . . | 53.6 | . . | 45.6 | . . | 45.5 | . . | . . | 45.1 | . . | . . |
| | 79 | 38 25 | 125 57 | 58.0 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| Nov. 5 | 81 | 37 34 | 125 25 | 58.2 | 57.5 | . . | 54.6 | . . | 52.1 | . . | . . | 46.5 | . . | 45.2 | . . | . . |
| Nov. 6 | 82 | 37 40 | 123 36 | 55.0 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |

EXPERIMENTAL TRIP OFF SAN FRANCISCO.

| Temperatures at depths of— | | | | | | | | | | | | | | | | | Bottom. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fms. 200 | Fms. 250 | Fms. 300 | Fms. 350 | Fms. 400 | Fms. 450 | Fms. 500 | Fms. 600 | Fms. 700 | Fms. 800 | Fms. 900 | Fms. 1000 | Fms. 1100 | Fms. 1200 | Fms. 1300 | Fms. 1400 | Fms. 1500 | Depth. Fms. | Tem. |
| ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | | ° |
| | | | | | | | | | | | | | | | | | 830 | 36.4 |
| | | | | | | | | | | | | | | | | | 1015 | 35.8 |
| | | | | | | | | | | | | | | | | | 1195 | 35.2 |
| | | | | | | | | | | | | | | | | | 1361 | 34.0 |

ON SHORE BETWEEN CAPE FLATTERY AND SAN FRANCISCO.

| Fms. 200 | Fms. 250 | Fms. 300 | Fms. 350 | Fms. 400 | Fms. 450 | Fms. 500 | Fms. 600 | Fms. 700 | Fms. 800 | Fms. 900 | Fms. 1000 | Fms. 1100 | Fms. 1200 | Fms. 1300 | Fms. 1400 | Fms. 1500 | Depth. Fms. | Tem. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | | ° |
| | | | | | | | | | | | | | | | | | 1387 | |
| 41.2 | | | | | | | | | | | | | | | | | 1385 | |
| | | 39.4 | | | | | | | | | | | | | | | 1492 | |
| 40.4 | | 38.7 | | 38.3 | | | | | | | | | | | | | 1535 | 34.0 |
| | | | | | | | | | | | | | | | | | 1539 | |
| | | | | | | 37.6 | | 36.1 | | | | | | | | | 1576 | |
| | | | | | | | 37.1 | | | | | | | | | | 1498 | |
| | | | | | | | | | | | | | | | | | 1532 | 33.8 |
| 41.6 | | 39.3 | | 38.2 | | 37.5 | 36.7 | | | | | | | | | | 834 | 35.4 |
| | | | | | | | | | | | | | | | | | 294 | 39.9 |
| | | | | | | | | | | | | | | | | | 237 | 41.0 |
| 41.4 | | 39.9 | | 38.4 | | 37.9 | 37.0 | 36.3 | | 35.0 | | | | | | | 1270 | 34.6 |
| | | | | | | | | | | | | | | | | | 1684 | |
| 41.6 | | | | 38.7 | | | | | 35.8 | | | | | | | | 1689 | 33.6 |
| 40.9 | | | | 38.9 | | | | | | | | | | | | | 1667 | |
| 42.2 | | 39.8 | | | | 37.8 | | 36.8 | | | 35.2 | | | | | | 1805 | 32.9 |
| 42.3 | | 41.4 | | | | 38.6 | | 36.5 | | | | | | | | | 1707 | |
| 42.0 | | | | | | | | | 35.3 | | | | | | | | 996 | 35.8 |
| | | | | | | | | | | | | | | | | | 1689 | 34.0 |
| 41.8 | | 40.0 | | | | | | | | | | | | | | | 1356 | |
| | | | | | | | | | | | | | | | | | 1499 | 34.3 |
| 41.3 | | | | | | | | | | | | | | | | | 1703 | |
| | | 39.9 | | | | 37.8 | | | | | | | | | | | 1666 | |
| 42.1 | | 41.0 | | | | | | | | | | | | | | | 1698 | |
| | | 40.8 | | | | 38.1 | | 36.2 | | | | | | | | | 1666 | 33.5 |
| | | | | | | | | | | | | | | | | | 966 | 35.1 |
| | | | | | | | | | | | | | | | | | 358 | |
| | | | | | | | | | | | | | | | | | 261 | |
| | | | | | | | | | | | | | | | | | 544 | 37.2 |
| | | | | | | | | | | | | | | | | | 731 | 35.9 |
| | | | | | | | | | | | | | | | | | 1166 | |
| | | | | | | | | | | | | | | | | | 821 | |
| 40.5 | | | | | | | | | | | | | | | | | 1567 | |
| | | | | | | 38.3 | | | | | | | | | | | 2263 | |
| | | | | | | | | | | | | | | | | | 2006 | 33.1 |
| | | | | | | | | | | | | | | | | | 1984 | 33.2 |
| | | | | | | 37.6 | | | | | 34.7 | | | | | | 1832 | |
| | | | | 39.0 | | | | | | | | | | | | | 911 | 35.2 |
| | | | | | | | | | | | | | | | | | 1586 | 33.6 |
| 41.4 | | 39.4 | | | | | | | | | | | | | | | 2068 | 33.3 |
| | | | | | | 37.7 | | | | | | | | | | | 2308 | 33.2 |
| | | | | | | | | | | | | | | | | | 2257 | 33.2 |
| | | 40.3 | | | | | | | | | | | | | | | 1726 | |

SERIAL TEMPERATURES OBTAINED ON LINES OF SOUNDINGS OFF AND

| Date. | No. of cast. | Position. Lat. | Position. Long. | Surface-temperature. | Temperatures at depths of— Fms. 10 | Fms. 20 | Fms. 30 | Fms. 40 | Fms. 50 | Fms. 60 | Fms. 70 | Fms. 80 | Fms. 90 | Fms. 100 | Fms. 130 | Fms. 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1873. | | N. ° ′ | W. ° ′ | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° |
| Dec. 20 | 3 | 37 15 | 122 59 | 55.1 | | | | | | | 47.7 | | | | | |
| Dec. 21 | 7 | 36 37 | 123 56 | 53.8 | | | | | 47.0 | | | | | 44.0 | | 43.2 |
| | 8 | 36 34 | 123 37 | 53.2 | | 52.9 | | 49.5 | | 47.3 | | 45.9 | | 45.3 | | 43.8 |
| | 9 | 36 32 | 123 11 | 54.0 | | | | | | | | | | | | |
| Dec. 22 | 10 | 36 27 | 122 54 | 54.0 | | | | | | | | | | | | |
| | 11 | 36 28 | 122 31 | 55.5 | | | 53.4 | | 50.6 | | | | | 46.3 | | 45.0 |
| | 12 | 36 26 | 122 09 | 55.0 | | | | | | | | | | | | |
| | 13 | 36 25 | 122 04 | 54.0 | | | | | | | | | | | | |
| Dec. 24 | 15 | 36 10 | 121 56 | 55.0 | | 53.0 | | | 50.5 | | 48.9 | | | 47.0 | | 45.5 |
| | 16 | 36 06 | 122 04 | 55.0 | | | | | | | | | | | | |
| | 17 | 36 02 | 122 12 | 54.9 | 53.3 | | | | 48.3 | | | | | 45.9 | | 44.1 |
| Dec. 25 | 18 | 35 52 | 122 29 | 55.0 | | | | | | | | | | | | |
| | 19 | 35 40 | 122 52 | 55.0 | 53.2 | | | | 48.7 | | | | | 45.2 | | 44.1 |
| | 20 | 35 28 | 122 44 | 54.1 | | | | | 49.2 | | | | | 46.9 | | |
| | 21 | 35 26 | 122 17 | 55.0 | | 52.5 | | 50.3 | | 48.5 | | 47.2 | | 45.8 | | 44.4 |
| | 22 | 35 24 | 121 52 | 55.0 | | | | | | | | | | | | |
| Dec. 26 | 24 | 35 19 | 121 31 | 55.0 | | | | | | | | | | | | |
| | 25 | 35 17 | 121 21 | 55.0 | | 53.6 | | 53.0 | 51.6 | | 50.0 | | | | | |
| | 26 | 35 15 | 121 12 | 55.0 | | | | | | | | | | | | |
| | 28 | 35 15 | 120 58 | 54.3 | | | | | | | | | | | | |
| | 30 | 34 59 | 120 47 | 54.1 | | | | | | | | | | | | |
| | 32 | 34 45 | 121 06 | 55.0 | | 52.1 | | 50.0 | | 47.7 | | 46.4 | | 46.0 | | 44.2 |
| | 33 | 34 36 | 121 16 | 55.2 | | | | | | | | | | | | |
| Dec. 27 | 34 | 34 23 | 121 32 | 57.0 | | | | | | | | | | | | |
| | 35 | 34 29 | 121 23 | 56.0 | | | | | | | | | | | | |
| | 36 | 34 09 | 121 33 | 57.0 | | | | | | | | | | | | |
| | 37 | 34 03 | 121 14 | 55.6 | | 51.9 | | 49.5 | | 47.2 | | 46.8 | | 46.4 | | 44.5 |
| | 38 | 33 59 | 121 13 | 56.0 | | | | | | | | | | | | |
| Dec. 28 | 39 | 33 46 | 121 05 | 56.0 | | | | | | | | | | | | |
| | 40 | 33 41 | 120 50 | 57.0 | | 55.0 | | 48.9 | | 48.0 | | | | 46.9 | | 43.9 |
| | 41 | 33 38 | 120 38 | 56.8 | | | | | | | | | | 46.8 | | |
| | 42 | 33 35 | 120 28 | 56.4 | | | | | | | | | | | | |
| | 43 | 33 33 | 120 14 | 56.0 | | | | | | | | | | | | |
| | 44 | 33 32 | 119 59 | 56.4 | | | | | | | | | | | | |
| Dec. 29 | 46 | 33 07 | 119 58 | 57.0 | | | | | | | | | | | | |
| | 47 | 32 54 | 120 09 | 57.0 | | | | | | | | | | | | |
| | 48 | 32 41 | 120 16 | 57.0 | | 55.2 | | 51.8 | 50.5 | | | 47.5 | | 46.2 | | |
| | 49 | 32 29 | 120 08 | 59.6 | | | | | | | | | | | | |
| | 50 | 32 29 | 119 52 | 58.0 | | | | | | | | | | | | |
| | 51 | 32 28 | 119 32 | 59.0 | | | | | | | | | | | | |
| | 52 | 32 23 | 119 21 | 59.5 | | | | | | | | | | | | |
| | 53 | 32 14 | 119 07 | 59.9 | | | | | | | | | | | | |
| Dec. 30 | 55 | 32 18 | 118 27 | 59.0 | | | | | | | | | | | | |
| | 56 | 32 22 | 118 52 | 58.4 | | | | | | | | | | | | |
| | 57 | 32 22 | 117 44 | 59.6 | | | | | | | | | | | | |
| | 58 | 32 33 | 117 28 | 59.8 | | | | | | | | | | | | |

ON SHORE BETWEEN SAN FRANCISCO AND SAN DIEGO, CALIFORNIA.

| Temperatures at depths of— | | | | | | | | | | | | | | | | | Bottom. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fms. 200 | Fms. 250 | Fms. 300 | Fms. 350 | Fms. 400 | Fms. 450 | Fms. 500 | Fms. 600 | Fms. 700 | Fms. 800 | Fms. 900 | Fms. 1000 | Fms. 1100 | Fms. 1200 | Fms. 1300 | Fms. 1400 | Fms. 1500 | Depth, Fms. | Tem. |
| ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | | ° |
| | | | | | | | | | | | | | | | | | 358 | 39.8 |
| 40.9 | | 39.8 | | | | | | | | | | | | | | | 2104 | 33.1 |
| | | | | | | | | | | | | | | | | | 1940 | |
| | | | | | | | | | | | | | | | | | 1685 | 33.3 |
| | | | | | | | | | | | | | | | | | 1650 | 33.9 |
| 43.3 | | | | | | | | | | | | | | | | | 1170 | 34.8 |
| | | | | | | | | | | | | | | | | | 486 | 38.8 |
| | | | | | | | | | | | | | | | | | 190 | 44.9 |
| | | | | | | | | | | | | | | | | | 686 | 37.3 |
| | | | | | | | | | | | | | | | | | 988 | 35.4 |
| 43.6 | | 41.4 | | | | | | | | | | | | | | | 882 | 35.6 |
| | | | | | | | | | | | | | | | | | 1814 | 33.3 |
| 42.7 | | 40.8 | | | | | | | | | | | | | | | 1995 | 33.7 |
| 44.7 | | 41.1 | | 40.0 | | 38.8 | | | | | | | | | | | 1940 | 33.2 |
| 43.6 | | | | | | | | | | | | | | | | | 2014 | |
| | | | | | | | | | | | | | | | | | 862 | 35.7 |
| | | | | | | | | | | | | | | | | | 437 | 39.0 |
| | | | | | | | | | | | | | | | | | 371 | 40.3 |
| | | | | | | | | | | | | | | | | | 289 | 42.5 |
| | | | | | | | | | | | | | | | | | 65 | 48.0 |
| | | | | | | | | | | | | | | | | | 80 | 48.0 |
| | | | | | | | | | | | | | | | | | 309 | 41.8 |
| | | | | | | | | | | | | | | | | | 490 | 39.2 |
| | | | | | | | | | | | | | | | | | 1995 | 33.2 |
| | | | | | | | | 37.7 | 37.1 | 36.1 | | | | | | | 1198 | 34.7 |
| 45.1 | | | | 40.2 | | | 37.9 | | 36.3 | | 35.8 | | | | | | 1988 | |
| | | | | | | | | | | | | | | | | | 1783 | 33.7 |
| | | | | | | | | | | | | | | | | | 1467 | 34.1 |
| | | | | | | | | | | | | | | | | | 1674 | 33.8 |
| 42.9 | | | | | | | | | | | | | | | | | 1092 | 35.2 |
| 43.2 | | 41.7 | | 39.9 | | | | | | | | | | | | | 530 | 38.8 |
| | | | | | | | | | | | | | | | | | 694 | 37.3 |
| | | | | | | | | | | | | | | | | | 631 | 38.4 |
| | | | | | | | | | | | | | | | | | 260 | 43.0 |
| | | | | | | | | | | | | | | | | | 542 | 39.1 |
| | | | | | | | | | | | | | | | | | 551 | 39.1 |
| | | | | | | | | | | | | | | | | | 1833 | 33.7 |
| | | | | | | | | | | | | | | | | | 1052 | 35.4 |
| | | | | | | | | | | | | | | | | | 844 | 36.9 |
| | | | | | | | | | | | | | | | | | 769 | 36.8 |
| | | | | | | | | | | | | | | | | | 759 | 36.9 |
| | | | | | | | | | | | | | | | | | 727 | 37.1 |
| | | | | | | | | | | | | | | | | | 955 | 36.8 |
| | | | | | | | | | | | | | | | | | 445 | 39.7 |
| | | | | | | | | | | | | | | | | | 784 | 36.8 |
| | | | | | | | | | | | | | | | | | 687 | 37.5 |

SERIAL TEMPERATURES OBTAINED ON LINE OF SOUNDINGS

| Date. | No. of cast. | Position. Lat. | Long. | Surface-temperature. | Temperatures at depths of— Fms. 10 | Fms. 20 | Fms. 30 | Fms. 40 | Fms. 50 | Fms. 60 | Fms. 70 | Fms. 80 | Fms. 90 | Fms. 100 | Fms. 130 | Fms. 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1874. | | N. ° ′ | W. ° ′ | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° |
| Jan. 6 | 3 | 32 30 | 117 21 | 57.8 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 4 | 32 27 | 117 27 | 58.0 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 5 | 32 17 | 117 47 | 58.8 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| Jan. 7 | 7 | 32 00 | 118 26 | 59.6 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 8 | 31 56 | 118 41 | 59.1 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 9 | 31 51 | 119 03 | 59.8 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 10 | 31 43 | 119 28 | 59.0 | . . | 57.4 | . . | 51.5 | . . | 48.8 | . . | 47.5 | . . | 46.3 | . . | 44.7 |
| Jan. 8 | 11 | 31 25 | 120 04 | 58.7 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 12 | 31 01 | 120 46 | 61.0 | . . | . . | . . | . . | . . | . . | . . | . . | . . | 46.8 | . . | . . |
| | 13 | 30 52 | 121 37 | 60.0 | . . | 57.0 | 57.0 | 54.0 | 51.5 | 49.8 | 48.8 | 48.6 | 48.0 | . . | . . | 45.2 |
| Jan. 9 | 14 | 30 39 | 122 28 | 60.4 | 59.7 | 59.6 | 59.6 | 59.0 | 51.9 | 54.3 | 52.2 | 48.3 | 48.1 | 47.3 | . . | 46.0 |
| | 15 | 30 31 | 123 15 | 61.0 | . . | . . | . . | . . | 57.9 | . . | . . | . . | . . | 48.3 | . . | 45.5 |
| Jan. 10 | 16 | 30 16 | 124 08 | 63.0 | . . | . . | . . | . . | 61.5 | . . | . . | . . | . . | 50.2 | . . | . . |
| | 17 | 29 55 | 125 12 | 63.1 | . . | . . | 59.7 | . . | 59.7 | . . | 59.2 | . . | . . | 51.9 | . . | 47.0 |
| Jan. 11 | 18 | 29 53 | 126 06 | 63.0 | . . | . . | 61.3 | . . | 59.6 | . . | 57.7 | 51.5 | 50.9 | 49.5 | . . | . . |
| | 19 | 29 39 | 126 59 | 63.2 | . . | . . | . . | . . | 59.4 | . . | . . | . . | . . | 52.4 | . . | . . |
| Jan. 12 | 20 | 29 15 | 128 05 | 61.8 | 56.6 | . . | 57.3 | . . | 56.7 | . . | . . | 56.5 | . . | 53.0 | . . | 46.5 |
| | 21 | 28 58 | 128 48 | 63.4 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 22 | 28 42 | 129 31 | 61.5 | . . | . . | 58.9 | . . | 58.5 | . . | . . | 58.8 | 56.9 | 52.9 | . . | 47.1 |
| Jan. 13 | 23 | 28 22 | 130 28 | 61.1 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| Jan. 14 | 24 | 28 19 | 131 19 | 65.0 | 61.6 | 61.1 | . . | 63.1 | . . | 62.5 | . . | 62.4 | . . | 58.6 | . . | 49.4 |
| | 25 | 28 08 | 132 05 | 66.4 | 65.5 | . . | 65.3 | . . | 65.3 | . . | 65.1 | . . | 61.7 | 63.6 | 62.2 | 57.9 |
| Jan. 17 | 26 | 28 03 | 132 35 | 65.2 | 64.2 | . . | 63.0 | . . | 62.6 | . . | 61.8 | . . | 61.7 | 59.3 | . . | 50.4 |
| Jan. 18 | 27 | 27 45 | 133 22 | 65.6 | . . | . . | . . | . . | 61.4 | . . | . . | . . | . . | 59.9 | 51.8 | 49.1 |
| | 28 | 27 30 | 134 11 | 66.2 | . . | . . | 64.8 | . . | . . | . . | . . | 61.2 | . . | 57.5 | 50.1 | 48.8 |
| Jan. 19 | 29 | 27 10 | 134 58 | 66.2 | . . | . . | . . | 61.1 | . . | 63.1 | . . | 62.3 | . . | 56.6 | 52.3 | 49.5 |
| | 30 | 26 51 | 135 51 | 66.0 | 65.2 | . . | 65.2 | . . | 65.1 | . . | 62.2 | . . | . . | 56.2 | 51.1 | 48.6 |
| | 31 | 26 36 | 136 38 | 66.4 | . . | 66.2 | 66.2 | . . | 65.3 | 61.3 | . . | 63.4 | . . | 58.6 | . . | 49.8 |
| Jan. 20 | 32 | 26 22 | 137 22 | 67.8 | . . | . . | 67.8 | . . | 67.8 | 67.6 | . . | 63.9 | . . | 61.4 | 55.2 | 50.4 |
| | 33 | 26 15 | 138 10 | 69.2 | . . | . . | . . | . . | 69.0 | 68.7 | 68.6 | 65.8 | 61.8 | 61.8 | 55.1 | 50.5 |
| Jan. 21 | 34 | 26 09 | 139 00 | 68.8 | . . | . . | . . | . . | 67.2 | . . | 65.9 | 64.3 | . . | 63.4 | 51.2 | 50.2 |
| | 35 | 25 59 | 139 45 | 68.8 | . . | . . | . . | . . | 68.0 | . . | 61.6 | . . | . . | 61.1 | . . | 49.4 |
| Jan. 22 | 36 | 25 52 | 140 40 | 68.0 | . . | . . | . . | . . | 65.0 | 65.0 | 63.7 | 63.3 | 61.1 | 59.8 | 51.6 | 49.6 |
| | 37 | 25 43 | 141 31 | 68.0 | . . | 67.2 | 67.2 | 67.0 | 66.8 | . . | 61.0 | 63.3 | 63.3 | 60.7 | 53.1 | 50.3 |
| | 38 | 25 36 | 142 14 | 69.2 | . . | . . | . . | . . | 68.5 | . . | . . | 61.9 | . . | 60.6 | 51.7 | 51.5 |
| Jan. 25 | 39 | 25 21 | 142 29 | 69.5 | . . | . . | 68.8 | . . | 68.8 | . . | 68.7 | . . | . . | 63.2 | 58.5 | 55.4 |
| | 40 | 25 08 | 143 18 | 69.2 | . . | . . | . . | . . | 69.0 | . . | 65.6 | . . | . . | 61.4 | . . | 53.4 |
| Jan. 26 | 41 | 24 59 | 144 04 | 70.0 | . . | . . | . . | . . | . . | . . | . . | . . | . . | 63.0 | . . | . . |
| | 42 | 24 49 | 144 52 | 70.6 | . . | . . | . . | . . | 68.7 | 68.4 | 66.2 | 65.5 | 64.3 | 61.4 | 51.0 | 52.4 |
| Jan. 27 | 43 | 24 40 | 145 35 | 70.8 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 44 | 24 23 | 146 19 | 70.0 | . . | . . | . . | . . | 68.9 | . . | 67.3 | . . | 64.0 | 60.5 | . . | 52.2 |
| Jan. 28 | 45 | 24 08 | 147 03 | 70.6 | . . | . . | . . | . . | 68.8 | 68.8 | 68.6 | 68.2 | 68.0 | 63.3 | 56.2 | 55.4 |
| | 46 | 23 51 | 147 47 | 72.8 | . . | . . | . . | . . | . . | . . | . . | . . | . . | 64.3 | . . | . . |
| Jan. 29 | 47 | 23 38 | 148 42 | 72.0 | . . | . . | . . | . . | 68.6 | . . | 68.3 | . . | 66.5 | 65.0 | 58.2 | 54.1 |
| | 48 | 23 20 | 149 37 | 72.6 | 71.4 | 71.4 | 71.3 | 71.1 | 70.3 | 70.3 | . . | 67.3 | 66.6 | 64.9 | 62.1 | 52.9 |
| | 49 | 23 10 | 150 31 | 72.8 | . . | . . | . . | . . | 70.5 | . . | 67.9 | . . | . . | 64.0 | . . | 54.2 |
| Jan. 30 | 50 | 23 01 | 151 26 | 71.2 | . . | . . | . . | . . | 70.2 | . . | 68.2 | . . | . . | 64.5 | 55.6 | 52.8 |
| | 51 | 22 50 | 152 17 | 73.4 | . . | . . | . . | . . | 71.0 | . . | 68.6 | 67.5 | 66.5 | 64.6 | 57.9 | 52.5 |
| Jan. 31 | 52 | 22 40 | 153 17 | 71.9 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 53 | 22 26 | 154 01 | 73.2 | . . | . . | 71.9 | . . | 71.3 | . . | 68.4 | 66.0 | 65.1 | 62.9 | 58.1 | 53.6 |
| Feb. 1 | 54 | 22 10 | 154 52 | 72.5 | . . | . . | . . | . . | 70.9 | . . | . . | . . | . . | 63.2 | . . | 54.2 |
| | 55 | 21 55 | 155 39 | 74.0 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 56 | 21 43 | 156 21 | 73.7 | . . | . . | . . | . . | 72.0 | . . | 70.5 | 68.9 | 67.8 | 66.2 | 60.0 | 55.0 |
| Feb. 2 | 57 | 21 32 | 157 01 | 73.0 | . . | 72.5 | . . | 72.4 | . . | 70.8 | . . | 68.6 | . . | 65.1 | 60.2 | 54.2 |
| | 58 | 21 26 | 157 19 | 73.2 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 59 | 21 24 | 157 26 | 73.3 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 60 | 21 14 | 157 36 | 74.0 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 61 | 21 12 | 157 42 | 73.6 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 62 | 21 13 | 157 47 | 73.3 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |

BETWEEN SAN DIEGO, CALIFORNIA, AND HONOLULU, HAWAIIAN ISLANDS.

| Temperatures at depths of— | | | | | | | | | | | | | | | | | Bottom. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fms. 200 | Fms. 250 | Fms. 300 | Fms. 350 | Fms. 400 | Fms. 450 | Fms. 500 | Fms. 600 | Fms. 700 | Fms. 800 | Fms. 900 | Fms. 1000 | Fms. 1100 | Fms. 1200 | Fms. 1300 | Fms. 1400 | Fms. 1500 | Depth Fms. | Tem. |
| ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | | ° |
| | | | | | | | | | | | | | | | | | 622 | 38.4 |
| | | | | | | | | | | | | | | | | | 579 | 38.8 |
| | | | | | | | | | | | | | | | | | 1053 | 36.3 |
| | | | | | | | | | | | | | | | | | 595 | 38.6 |
| | | | | | | | | | | | | | | | | | 566 | 38.6 |
| | | | | | | | | | | | | | | | | | 980 | 36.2 |
| | | | | | | | | | | | | | | | | | 1915 | 34.0 |
| | | | | | | | | | | | | | | | | | 2177 | 33.9 |
| 43.2 | | 40.8 | | 40.2 | | 39.6 | | | | | | | | | | | 2178 | 33.9 |
| 43.9 | | | | | | | | | | | | | | | | | 2246 | 33.8 |
| 44.1 | | | | | | | | | | | | | | | | | 2251 | 33.9 |
| 43.0 | | | | | | | | | | | | | | | | | 2103 | 33.9 |
| 44.5 | | | | 40.1 | | | 37.5 | | 36.4 | | 35.7 | | | | | | 2363 | 33.9 |
| 44.4 | | 40.5 | | | | | | | | | | | | | | | 2049 | 33.8 |
| | | | | | | | | | | | | | | | | | 2199 | 33.9 |
| | | 41.3 | | | | 39.0 | | 36.7 | | 35.6 | | 35.4 | | | | | 2400 | 33.8 |
| 44.8 | | | | | | | | | | | | | | | | | 2409 | 33.7 |
| 43.8 | | | | 39.5 | | | 37.6 | | 36.1 | | 35.4 | | 35.1 | 34.7 | | | 2517 | 33.8 |
| 43.9 | | | | | | | | | | | | | | | | | 2583 | 33.7 |
| | | 40.8 | | | | 38.8 | | 36.9 | | 35.8 | | 35.0 | | 34.7 | 34.6 | | 2587 | 33.7 |
| 46.0 | 43.5 | | | | | | | | | | | | | | | | 2604 | 33.2 |
| 48.5 | | | | | | | | | | | | | | | | | 2356 | 33.7 |
| 46.5 | 43.8 | 41.5 | 40.3 | 40.0 | | 38.8 | | | | | | | | | | | 2323 | 33.7 |
| 44.9 | 43.1 | 41.2 | | 39.8 | | 38.4 | 37.7 | | | | | | | | | | 2540 | 33.7 |
| 45.9 | 43.8 | 41.4 | | | | 38.6 | | 37.5 | | | | | | | | | 2477 | 33.6 |
| 45.6 | 42.7 | | | | | | | | | | | | | | | | 2541 | 33.7 |
| 45.1 | 42.4 | | | | | | | | | | | | | | | | 2440 | 33.7 |
| | | | | | | | | | | | | | | | | | 2356 | 33.7 |
| 46.9 | 43.2 | 40.9 | | | | | | | | | | | | | | | 2159 | 32.6 |
| 46.6 | 43.0 | 41.3 | 40.3 | 39.4 | | 38.5 | | | | | | | | | | | 2650 | 33.6 |
| 45.8 | 43.4 | | | | | | | | | | | | | | | | 2689 | 33.6 |
| 45.5 | 43.1 | 41.3 | 40.3 | 39.3 | 38.6 | 38.5 | 37.8 | | | | | | | | | | 2628 | 33.6 |
| | | | | | | | | | | | | | | | | | 2695 | 33.6 |
| 46.1 | 43.4 | 41.1 | | | | | | | | | | | | | | | 2553 | 33.8 |
| 47.9 | | | | | | | | | | | | | | | | | 2618 | 33.3 |
| 48.4 | 45.3 | | | | | | | | | | | | | | | | 2690 | 33.6 |
| 47.5 | 43.4 | 41.7 | | | | | | | | | | | | | | | 2634 | 33.6 |
| 48.9 | | 42.5 | | 39.7 | | 39.2 | 38.4 | 37.0 | 36.9 | 35.9 | 35.3 | 35.1 | 34.6 | | | | 2841 | 33.2 |
| 47.2 | 43.8 | 41.3 | | | | | | | | | | | | | | | 2841 | 33.6 |
| | | | | | | | | | | 36.0 | 35.7 | 35.1 | 34.6 | 34.2 | 34.3 | | 2856 | 33.8 |
| 46.7 | 44.4 | 41.4 | | | | | | | | | | | | | | | 2982 | 33.6 |
| 48.2 | 44.2 | | | | | | | | | | | | | | | | 2922 | 33.6 |
| 48.3 | | 41.6 | | 39.9 | | 38.7 | 38.0 | | 35.8 | | 35.5 | | 34.5 | | 34.3 | | 2993 | 33.7 |
| 49.4 | 45.0 | | | | | | | | | | | | | | | | 2982 | 33.6 |
| 46.6 | 45.3 | 42.1 | | | | | | | | | | | | | | | 2936 | 33.3 |
| 48.2 | 44.4 | 42.1 | | | | | | | | | | | | | | | 3054 | 33.2 |
| 48 2 | 44.7 | | | | | | | | | | | | | | | | 3053 | 33.4 |
| 48.6 | | 42.2 | | 40.1 | | 39.1 | 38.2 | 37.8 | | | | | | | | | 2953 | 33.2 |
| | | | | | | | | 37.4 | 36.9 | 36.1 | 34.9 | | 34.7 | 34.6 | | | 2726 | 33.6 |
| 47.7 | | | | | | | | | | | | | | | | | 2562 | 33.5 |
| 48.4 | 44.2 | 42.2 | | | | | | | | | | | | | | | 2488 | 33.5 |
| | | | | | | | | 37.2 | 36.6 | 35.4 | 35.2 | | 35.1 | | 34.3 | | 2752 | 33.2 |
| 48.7 | | | | | | | | | | | | | | | | | 3023 | 33.5 |
| | | | | | | | | | | | | | | | | | 2086 | 33.5 |
| | | | | | | | | | | | | | | | | | 498 | 40.4 |
| | | | | | | | | | | | | | | | | | 403 | 42.6 |
| | | | | | | | | | | | | | | | | | 63 | 70.4 |
| | | | | | | | | | | | | | | | | | 272 | 44.8 |
| | | | | | | | | | | | | | | | | | 255 | 45.1 |

SERIAL TEMPERATURES OBTAINED ON LINE OF SOUNDINGS

| Date. | No. of cast. | Position. | | Surface-temperature. | TEMPERATURES AT DEPTHS OF— | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Lat. | Long. | | Fms. 10 | Fms. 20 | Fms. 30 | Fms. 40 | Fms. 50 | Fms. 60 | Fms. 70 | Fms. 80 | Fms. 90 | Fms. 100 | Fms. 130 | Fms. 150 |
| 1874. | | N. ° ′ | W. ° ′ | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° |
| Mar. 17 | 3 | 21 06 | 158 31 | 75.0 | . . | . . | . . | . . | 72.8 | . . | . . | . . | . . | 65.5 | . . | 55.8 |
| Mar. 18 | 4 | 21 00 | 159 25 | 74.0 | . . | . . | . . | . . | 71.4 | . . | . . | . . | . . | 66.1 | . . | . . |
| | 5 | 20 54 | 160 22 | 73.0 | . . | . . | . . | . . | 70.7 | . . | . . | . . | . . | 63.3 | . . | . . |
| Mar. 19 | 6 | 20 48 | 161 19 | 74.0 | . . | . . | 71.2 | . . | 70.6 | . . | . . | 68.0 | . . | 64.1 | . . | . . |
| | 7 | 20 38 | 162 16 | 73.0 | . . | . . | . . | . . | 71.8 | . . | 71.0 | . . | 68.6 | 64.4 | . . | 55.7 |
| Mar. 20 | 8 | 20 25 | 163 25 | 74.4 | . . | . . | . . | . . | 70.0 | . . | 69.8 | . . | 69.8 | 67.7 | . . | 57.6 |
| | 9 | 20 18 | 164 27 | 73.7 | . . | . . | . . | . . | 70.3 | . . | . . | . . | . . | 65.9 | . . | . . |
| Mar. 21 | 10 | 20 13 | 165 31 | 73.0 | 70.5 | . . | . . | 70.4 | . . | . . | 69.2 | . . | . . | 63.5 | 58.8 | 55.6 |
| | 11 | 20 12 | 166 35 | 74.0 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| Mar. 22 | 12 | 20 12 | 167 46 | 74.0 | . . | . . | . . | . . | 72.2 | . . | 70.7 | . . | . . | 67.9 | . . | . . |
| | 13 | 20 16 | 168 57 | 74.6 | . . | . . | . . | . . | 73.3 | . . | . . | . . | . . | 69.5 | . . | 63.5 |
| Mar. 23 | 15 | 20 41 | 171 33 | 74.5 | . . | . . | . . | . . | 71.0 | . . | . . | 69.9 | . . | 69.6 | 64.3 | 59.9 |
| Mar. 24 | 16 | 20 52 | 172 39 | 74.0 | . . | . . | . . | . . | . . | . . | . . | . . | . . | 71.2 | . . | 61.9 |
| | 17 | 21 01 | 173 51 | 74.2 | . . | . . | . . | . . | 71.3 | . . | . . | 71.0 | . . | 68.9 | . . | . . |
| Mar. 25 | 18 | 21 21 | 174 57 | 74.1 | . . | . . | . . | . . | 71.4 | . . | . . | 68.9 | . . | 66.6 | . . | 58.2 |
| | 19 | 21 27 | 176 03 | 74.2 | . . | . . | . . | . . | 70.2 | . . | . . | 65.9 | . . | 62.7 | 59.8 | 55.2 |
| Mar. 26 | 20 | 21 21 | 177 10 | 73.2 | . . | 71.1 | 70.9 | 70.3 | . . | . . | 70.9 | . . | 70.6 | 70.5 | . . | 62.9 |
| | 21 | 21 29 | 178 15 | 73.2 | . . | . . | . . | . . | . . | . . | . . | . . | . . | 70.2 | . . | 58.5 |
| Mar. 27 | 22 | 21 38 | 179 27 | 74.6 | . . | . . | . . | . . | 73.0 | . . | . . | . . | . . | 65.5 | . . | . . |
| | | N. | E. | | | | | | | | | | | | | |
| Mar. 29 | 23 | 21 40 | 179 20 | 73.0 | . . | . . | . . | . . | 71.7 | . . | . . | . . | . . | 65.6 | . . | . . |
| | 24 | 21 41 | 178 04 | 74.6 | . . | . . | . . | . . | 70.8 | . . | . . | . . | . . | 65.3 | 60.9 | 58.2 |
| Mar. 30 | 25 | 21 41 | 176 50 | 74.7 | . . | . . | . . | . . | 72.1 | . . | . . | 69.3 | . . | 64.9 | . . | 58.7 |
| | 26 | 21 47 | 175 44 | 74.0 | . . | 72.3 | . . | 71.7 | . . | 71.7 | . . | 71.6 | . . | 67.0 | . . | . . |
| Mar. 31 | 27 | 21 56 | 174 44 | 75.0 | . . | . . | . . | . . | . . | . . | . . | . . | . . | 63.5 | . . | . . |
| | 28 | 22 01 | 173 43 | 73.0 | . . | . . | 72.1 | . . | 71.7 | . . | 70.9 | . . | . . | 65.9 | 60.5 | 58.6 |
| April 1 | 29 | 22 05 | 172 41 | 73.2 | . . | . . | . . | . . | 70.8 | . . | . . | . . | . . | 63.6 | . . | 58.2 |
| | 30 | 22 09 | 171 32 | 74.7 | . . | 71.6 | . . | 71.5 | . . | 71.3 | . . | 71.0 | . . | 68.1 | 63.1 | . . |
| April 2 | 31 | 22 20 | 170 31 | 73.8 | . . | . . | . . | . . | 71.4 | . . | . . | . . | . . | 64.2 | . . | 58.6 |
| | 32 | 22 29 | 169 28 | 75.5 | . . | . . | . . | . . | 72.5 | . . | . . | . . | . . | 69.4 | 63.1 | 60.5 |
| April 3 | 33 | 22 44 | 168 23 | 75.1 | 74.7 | . . | . . | . . | 72.6 | . . | 70.2 | . . | 65.2 | 63.8 | 61.2 | . . |
| | 34 | 22 51 | 167 21 | 75.8 | . . | . . | . . | . . | 71.5 | . . | . . | . . | . . | 65.9 | . . | 59.1 |
| April 4 | 35 | 22 59 | 166 13 | 75.0 | . . | . . | 71.6 | . . | 70.7 | . . | 67.9 | . . | 63.4 | 62.4 | 60.3 | 59.5 |
| | 36 | 23 05 | 165 13 | 76.0 | . . | . . | . . | . . | 70.1 | . . | . . | . . | . . | 62.2 | . . | 59.5 |
| April 5 | 37 | 23 09 | 164 03 | 74.5 | . . | 71.6 | . . | 71.0 | . . | 70.3 | . . | 69.1 | . . | 63.2 | . . | . . |
| | 38 | 23 17 | 162 58 | 76.0 | . . | . . | . . | . . | 71.8 | . . | . . | . . | . . | 64.8 | . . | 59.0 |
| April 6 | 39 | 23 31 | 161 51 | 76.0 | 73.5 | . . | 73.5 | . . | 73.7 | . . | 72.5 | . . | 70.2 | 67.8 | 63.8 | 61.2 |
| | 40 | 23 45 | 160 56 | 75.8 | . . | . . | . . | . . | . . | . . | . . | . . | . . | 69.8 | . . | . . |
| April 7 | 41 | 24 07 | 160 09 | 73.2 | . . | 71.6 | . . | 69.8 | . . | 67.3 | . . | 62.9 | . . | 60.9 | . . | . . |
| | 42 | 24 19 | 159 21 | 74.7 | . . | . . | 72.8 | . . | 67.4 | . . | 66.5 | . . | . . | 62.4 | 61.2 | 59.4 |
| April 8 | 43 | 23 55 | 158 07 | 73.4 | . . | . . | . . | . . | . . | . . | . . | . . | . . | 62.6 | . . | . . |
| April 9 | 44 | 23 46 | 157 12 | 75.6 | . . | . . | 72.5 | . . | 72.4 | . . | 72.3 | . . | . . | 68.4 | 63.4 | 61.7 |
| | 45 | 23 56 | 156 10 | 73.2 | . . | . . | . . | 70.0 | . . | 67.5 | . . | 65.5 | . . | 62.8 | . . | . . |
| April 10 | 46 | 24 02 | 155 08 | 72.8 | . . | . . | . . | . . | 68.5 | . . | 66.8 | . . | . . | 62.1 | 60.8 | 60.6 |
| | 47 | 24 20 | 154 06 | 74.0 | . . | . . | 72.7 | . . | 71.2 | . . | 68.0 | . . | . . | 63.5 | 61.2 | 60.6 |
| April 11 | 49 | 24 41 | 151 46 | 74.0 | . . | . . | . . | . . | 71.3 | . . | . . | . . | . . | 64.2 | . . | 60.4 |
| April 12 | 50 | 24 46 | 150 51 | 75.1 | . . | . . | . . | . . | 72.7 | . . | 72.5 | . . | . . | 70.8 | 66.7 | 64.3 |
| | 51 | 25 11 | 149 46 | 72.4 | . . | . . | . . | 68.3 | . . | 66.3 | . . | 63.8 | . . | 62.6 | . . | . . |
| April 13 | 52 | 25 42 | 148 39 | 72.8 | . . | . . | . . | . . | . . | . . | . . | . . | . . | 61.9 | . . | . . |
| | 53 | 25 55 | 147 47 | 73.2 | . . | . . | 71.9 | . . | 68.8 | . . | 66.1 | . . | . . | 62.6 | 61.0 | 60.0 |
| April 14 | 54 | 26 09 | 146 10 | 70.0 | . . | . . | . . | . . | 68.4 | . . | 65.7 | . . | . . | 63.5 | 62.8 | 62.6 |
| | 55 | 26 18 | 144 54 | 74.9 | . . | . . | . . | 73.8 | . . | 73.4 | . . | 70.6 | . . | 69.6 | . . | . . |
| April 15 | 56 | 26 28 | 143 33 | 71.2 | . . | . . | . . | . . | 67.5 | . . | . . | . . | . . | 63.3 | . . | 61.2 |
| | 57 | 26 41 | 142 42 | 72.0 | . . | . . | . . | . . | 66.5 | . . | 64.6 | . . | . . | 61.4 | 60.4 | 59.9 |
| | 58 | 26 52 | 142 21 | 71.0 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 59 | 26 55 | 142 14 | 71.0 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |

BETWEEN HONOLULU, HAWAIIAN ISLANDS, AND PORT LLOYD, BONIN ISLANDS.

| TEMPERATURES AT DEPTHS OF— | | | | | | | | | | | | | | | | | BOTTOM. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fms. 200 | Fms. 250 | Fms. 300 | Fms. 350 | Fms. 400 | Fms. 450 | Fms. 500 | Fms. 600 | Fms. 700 | Fms. 800 | Fms. 900 | Fms. 1000 | Fms. 1100 | Fms. 1200 | Fms. 1300 | Fms. 1400 | Fms. 1500 | Depth. Fms. | Tem. |
| ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | | ° |
| 49.1 | 45.3 | 42.8 | | | | | | | | | | | | | | | 1580 | 33.6 |
| | | | | | | | | | | | | | | | | | 2418 | 32.9 |
| 48.6 | | 42.5 | | 40.0 | | 39.1 | 38.5 | | | | | | | | | | 2565 | 33.5 |
| 46.4 | | 41.8 | | 40.1 | | | | | | | | | | | | | 2555 | 33.1 |
| 49.4 | | 43.4 | | 40.5 | | 39.2 | 38.4 | | | | | | | | | | 2495 | 33.9 |
| 50.0 | | | | | | | | | | | | | | | | | 2733 | 33.9 |
| 49.4 | | 42.7 | | 40.2 | | 39.6 | 38.6 | | | | | | | | | | 2720 | 33.3 |
| | | | | | | | | | | | | | | | | | 2794 | 33.0 |
| | | | | | | | | 37.7 | 37.2 | 36.3 | 34.3 | | 34.3 | | | | 2803 | 33.6 |
| 50.4 | 46.3 | 43.6 | | | | | | | | | | | | | | | 2460 | 33.5 |
| 51.4 | | 42.7 | | 40.6 | | 39.3 | 38.8 | | | | | | | | | | 2737 | |
| 52.6 | | | | | | | | | | | | | | | | | 1874 | |
| 58.8 | 49.3 | 48.7 | 43.4 | 42.7 | | 40.7 | | | | | | | | | | | 3045 | |
| | | | | | | | | | | | | | | | | | 2952 | |
| 52.9 | | 43.8 | | 40.7 | | 39.9 | | | | | | | | | | | 2993 | |
| | | | | | | | | | | | | | | | | | 3106 | 33.4 |
| 55.8 | | 46.4 | | | | | | | | | | | | | | | 3100 | |
| 52.7 | 47.7 | | | | | | | | | | | | | | | | 2828 | |
| 51.7 | | 44.4 | | 40.1 | | 39.4 | | | | | | | | | | | 2725 | 33.2 |
| 53.2 | 48.4 | | | | | | | | | | | | | | | | 1964 | |
| 52.7 | 48.7 | 44.7 | | | | | | | | | | | | | | | 1625 | |
| | | | | | | | | | | | | | | | | | 1108 | 34.6 |
| 53.5 | | 41.5 | | 40.1 | | 39.0 | | | | | | | | | | | 1817 | 33.8 |
| 53.6 | | 44.3 | | 40.3 | | 39.6 | 38.4 | 38.3 | 36.7 | 36.3 | 35.5 | | | | | | 1613 | 34.2 |
| | | | | | | | | | | | | | | | | | 2813 | 33.2 |
| 53.4 | 48.7 | 45.2 | 42.1 | 40.2 | | 39.3 | | | | | | | | | | | 2836 | 33.9 |
| | | | | | | | | | | | | | | | | | 2771 | 33.6 |
| 54.4 | | 46.3 | | 41.2 | | 39.3 | 38.5 | | | | | | | | | | 3090 | 33.2 |
| 56.5 | | | | | | | | | | | | | | | | | 3211 | 33.2 |
| | | | | | | | | | | | | | | | | | 3262 | 33.7 |
| 56.4 | 52.3 | 47.8 | | 41.4 | | 39.3 | | | | | | | | | | | 3232 | 33.9 |
| | | | | | | | | | | | | | | | | | 3155 | 33.6 |
| 55.8 | 51.8 | 48.1 | | 41.8 | | 40.1 | | | | | | | | | | | 3185 | 33.7 |
| | | | | | | | | | | | | | | | | | 3148 | 33.2 |
| 56.0 | 52.3 | 48.2 | | 41.7 | | 39.4 | | | | | | | | | | | 2870 | 33.9 |
| 58.6 | | | | | | | | | | | | | | | | | 3009 | 33.2 |
| 57.1 | | 49.1 | | 42.3 | | 39.8 | 38.5 | | 35.9 | | 35.6 | | | | | | 1400 | 34.9 |
| | | | | | | | | | | | | | | | | | 3023 | 33.2 |
| 55.2 | | | | | | | | | | | | | | | | | 2938 | 33.8 |
| 55.1 | | 47.0 | | 41.4 | | | | | | | | | | | | | 2042 | |
| 57.2 | 53.1 | 48.9 | | | | | | | | | | | | | | | 2173 | 33.2 |
| 56.3 | | 46.4 | | 41.6 | | 39.7 | | | | | | | | | | | 3075 | |
| | | | | | | | | | | | | | | | | | 3273 | 33.2 |
| | | | | | | | | | | | | | | | | | 1499 | 34.1 |
| 58.2 | 53.8 | 48.7 | | 42.1 | | 39.6 | | | | | | | | | | | 3023 | |
| 59.3 | 54.0 | 50.1 | | | | | | | | | | | | | | | 3061 | |
| | | | | | | | | | | | | | | | | | 3287 | |
| 56.4 | | 48.4 | | 41.7 | | 39.3 | 38.0 | | 35.9 | | 35.5 | | | | | | 1712 | |
| | | | | | | | | | | | | | | | | | 2534 | 33.4 |
| 60.3 | 57.1 | | | | | | | | | | | | | | | | 3018 | |
| 59.8 | | 51.3 | | | | 40.2 | | 37.0 | | 35.8 | | 31.8 | | | | | 1700 | 33.8 |
| 58.4 | 53.5 | 50.3 | | | | | | | | | | | | | | | 2080 | 33.5 |
| | | | | | | | | | | | | | | | | | 1331 | 34.4 |
| | | | | | | | | | | | | | | | | | 814 | 35.7 |
| | | | | | | | | | | | | | | | | | 487 | 41.8 |

SERIAL TEMPERATURES OBTAINED ON LINE OF SOUNDINGS

| Date. | No. of cast | Position. Lat. | Position. Long. | Surface-temperature. | Fms. 10 | Fms. 20 | Fms. 30 | Fms. 40 | Fms. 50 | Fms. 60 | Fms. 70 | Fms. 80 | Fms. 90 | Fms. 100 | Fms. 130 | Fms. 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1874. | | N. ° ′ | E. ° ′ | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° |
| April 18 | 4 | 28 09 | 141 42 | 69.0 | | | | | 67.1 | | 65.8 | | | 63.7 | 62.1 | 60.6 |
| April 19 | 5 | 28 56 | 141 50 | 68.2 | | | | 66.5 | | 64.2 | | 63.9 | | 62.6 | | 58.8 |
| | 6 | 29 56 | 141 52 | 66.0 | | | | | 63.5 | | | | | 63.1 | | 61.2 |
| April 20 | 7 | 30 29 | 141 01 | 67.0 | | | | | 61.3 | | | | | 62.9 | | |
| | 8 | 31 18 | 140 53 | 63.0 | | | 62.6 | | | | 61.5 | | | 61.4 | 61.4 | |
| April 21 | 9 | 32 13 | 140 37 | 66.2 | | | | | | | | | | 62.9 | | 59.9 |
| | 10 | 32 58 | 140 22 | 68.0 | | | | | 66.0 | | | | | 64.2 | | 61.4 |
| April 22 | 12 | 34 31 | 140 14 | 62.5 | | | | | | | | | | | | |
| | 13 | 34 45 | 140 01 | 60.0 | | | | | | | | | | | | |

SERIAL TEMPERATURES OBTAINED ON LINES OF SOUNDINGS

| Date. | No. of cast | Position. Lat. | Position. Long. | Surface-temperature. | Fms. 10 | Fms. 20 | Fms. 30 | Fms. 40 | Fms. 50 | Fms. 60 | Fms. 70 | Fms. 80 | Fms. 90 | Fms. 100 | Fms. 130 | Fms. 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1874. | | N. ° ′ | E. ° ′ | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° |
| June 10 | 9 | 36 13 | 141 34 | 68.0 | | | | | 57.7 | | | | | 52.3 | | 47.4 |
| | 10 | 36 33 | 141 58 | 69.4 | | | | | 59.6 | | | | | 53.2 | | |
| | 11 | 36 58 | 142 15 | 70.4 | | | 65.4 | | 63.6 | | 61.6 | | | 58.4 | | |
| | 12 | 37 19 | 142 42 | 71.0 | | | | | | | | | | | | |
| June 11 | 13 | 37 37 | 143 09 | 69.0 | | | | | | | | | | 61.9 | | |
| | 14 | 37 54 | 143 40 | 68.2 | | 65.6 | | 63.5 | | 63.3 | | 62.6 | | 62.3 | | 60.8 |
| June 13 | 16 | 38 13 | 142 09 | 69.0 | | | | | | | | | | 58.4 | | |
| | 17 | 38 31 | 142 39 | 69.1 | | | | | 62.3 | | | | | 50.3 | | 46.8 |
| June 14 | 19 | 39 36 | 142 41 | 55.6 | | | | | 43.6 | | | | | 39.7 | | |
| | 20 | 40 10 | 142 57 | 60.2 | | 49.5 | | 45.6 | | 42.2 | | 37.9 | | 37.6 | | 37.6 |
| | 21 | 40 39 | 143 25 | 58.8 | | | | | 42.6 | | | | | 37.5 | | |
| June 15 | 23 | 41 25 | 144 47 | 60.3 | 58.5 | 56.5 | 55.6 | | 50.6 | | 45.6 | | | 42.7 | | |
| | 24 | 41 46 | 145 40 | 47.4 | | | | | 31.3 | | | | | 34.0 | | 31.5 |
| June 16 | 25 | 41 53 | 146 08 | 52.0 | 48.8 | 38.9 | 36.6 | 34.6 | 34.7 | | | | | 35.5 | | |
| | 26 | 42 08 | 146 50 | 51.4 | | | | | 35.3 | | | | | 35.4 | | |
| June 17 | 27 | 42 31 | 147 38 | 51.1 | 49.0 | 44.0 | 41.2 | 39.3 | 36.2 | 36.4 | | 35.5 | | 34.3 | | |
| | 28 | 42 57 | 148 23 | 49.5 | 42.7 | | | | 32.7 | | | | | 33.3 | | |
| | 29 | 43 21 | 149 12 | 43.0 | 40.2 | 31.3 | 33.6 | 32.5 | 32.3 | | | 33.2 | | 33.3 | | |
| June 18 | 30 | 43 47 | 150 02 | 49.3 | | | | | 33.3 | | | | | 33.5 | | |
| | 31 | 44 10 | 150 50 | 45.0 | 44.0 | 33.3 | 32.0 | | | 32.0 | | | | 32.9 | | |
| | 32 | 44 28 | 151 37 | 41.0 | | | | | 32.5 | | | | | 32.3 | | |
| June 19 | 33 | 44 55 | 152 26 | 41.4 | | | | | 32.3 | | | | | 31.5 | | |
| June 20 | 34 | 46 21 | 151 25 | 36.4 | | | | | | | | | | 34.6 | | |
| | 35 | 46 00 | 150 45 | 37.1 | | | | | 33.9 | | | | | 32.9 | | |
| June 21 | 37 | 45 07 | 149 46 | 39.5 | | | | | 31.4 | | | | | 33.4 | | |
| | 38 | 44 44 | 149 23 | 39.9 | | | | | | | | | | 34.5 | | |
| | 39 | 44 23 | 148 53 | 39.8 | | | | | | | | | | | | |
| June 22 | 40 | 44 02 | 148 16 | 39.2 | | | | | | | | | | | | |
| | 41 | 43 42 | 147 44 | 47.0 | | | | | | | | | | | | |
| | 42 | 43 20 | 147 04 | 50.9 | | | | | 31.2 | | | | | 35.2 | | |
| | 43 | 42 59 | 146 25 | 50.3 | | | | | 34.8 | | | | | 34.7 | | |
| June 23 | 44 | 42 36 | 145 49 | 50.2 | | | | | | | | | | | | |
| | 45 | 42 15 | 145 09 | 45.1 | | | | | | | | | | | | |
| | 46 | 41 54 | 144 35 | 49.8 | 42.5 | | | | | | | | | | | |
| | 47 | 41 32 | 144 18 | 59.5 | | | 47.2 | | | 44.9 | | | | 37.6 | | |
| July 4 | 48 | 46 38 | 151 47 | 36.8 | | | | | | | | | | | | |
| | 49 | 46 56 | 152 19 | 40.0 | | 36.0 | | | 33.7 | | 33.6 | | | | | |
| | 50 | 47 11 | 152 54 | 38.0 | 35.3 | 34.8 | 35.3 | 35.2 | 35.3 | | | | | | | |
| | 51 | 47 30 | 153 33 | 40.4 | | | | | | | | | | 34.4 | | |
| | 52 | 47 44 | 154 15 | 41.1 | | | | | | | | | | | | |

BETWEEN PORT LLOYD, BONIN ISLANDS, AND YOKOHAMA, JAPAN.

| Temperatures at depths of— | | | | | | | | | | | | | | | | | Bottom. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fms. 200 | Fms. 250 | Fms. 300 | Fms. 350 | Fms. 400 | Fms. 450 | Fms. 500 | Fms. 600 | Fms. 700 | Fms. 800 | Fms. 900 | Fms. 1000 | Fms. 1100 | Fms. 1200 | Fms. 1300 | Fms. 1400 | Fms. 1500 | Depth, Fms. | Tem. |
| ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | | ° |
| | | | | | | | | | | | | | | | | | 869 | 35.7 |
| 57.8 | | | | | | | | | | | | | | | | | 1344 | 34.4 |
| 58.9 | 54.9 | 51.5 | | | | | | | | | | | | | | | 2435 | 33.5 |
| 58.2 | | 50.6 | | 43.3 | | 40.6 | | | | | | | | | | | 1669 | 33.8 |
| | | | | | | | | | | | | | | | | | 1382 | 34.3 |
| 60.9 | | 53.2 | | 44.3 | | 40.9 | | | | | | | | | | | 1135 | 34.8 |
| 60.0 | 56.1 | 51.7 | 45.8 | 42.2 | | | | | | | | | | | | | 565 | |
| | | | | | | | | | | | | | | | | | 1618 | 33.8 |
| | | | | | | | | | | | | | | | | | 595 | 37.9 |

BETWEEN YOKOHAMA, JAPAN, AND TANAGA ISLAND, ALEUTIAN GROUP.

| Fms. 200 | Fms. 250 | Fms. 300 | Fms. 350 | Fms. 400 | Fms. 450 | Fms. 500 | Fms. 600 | Fms. 700 | Fms. 800 | Fms. 900 | Fms. 1000 | Fms. 1100 | Fms. 1200 | Fms. 1300 | Fms. 1400 | Fms. 1500 | Depth, Fms. | Tem. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | | ° |
| | | | 40.2 | 37.7 | | | | | | | | | | | | | 871 | 35.1 |
| | | | | | | | | | | | | | | | | | 1358 | 34.4 |
| 48.8 | | 41.3 | | | | | | | | | | | | | | | 1425 | |
| | | | | | | | | | | | | | | | | | 1274 | 34.4 |
| 58.6 | | 50.1 | | 42.6 | | 39.5 | 38.0 | | | | | | | | | | 1833 | |
| 57.9 | | 50.0 | | 42.5 | | | | | | | | | | | | | 3427 | 33.4 |
| 47.4 | | 38.2 | | 37.7 | | | | | | | | | | | | | 411 | |
| 45.4 | | | | | | | | | | | | | | | | | 1358 | 34.8 |
| 39.2 | | 38.3 | | 37.5 | | | | | | | | | | | | | 1017 | 35.3 |
| | | | | | | | | | | | | | | | | | 653 | |
| 36.6 | | 35.9 | | | | | | | | | | | | | | | 1137 | 34.8 |
| 36.3 | | 36.5 | | | | 36.5 | | | | | | | | | | | 2856 | |
| 34.5 | | | | 34.7 | | | 34.9 | | | | | | | | | | 3493 | |
| 35.6 | | | | | | 34.3 | | | | | | | | | | | 3587 | |
| | | 36.1 | | | | 35.7 | | | 35.3 | | 34.8 | | | | | | 3507 | 32.0 |
| | | | | | | | | | | | | | | | | | 4340 | |
| | | 33.6 | | | | 34.2 | | 33.5 | | | | | | | | | 4356 | |
| | | 33.2 | | | | 33.6 | | | | | | | | | | | 4041 | |
| 33.1 | | | | | | 34.3 | | | 33.0 | | | 33.2 | | | | | 4234 | |
| 35.4 | | | | | | | 34.4 | | | | | | 32.9 | | | | 4120 | |
| 33.5 | | 33.4 | | 32.0 | | | | | | | | | | | | | 4411 | |
| 34.4 | | 35.3 | | | | 33.7 | | | | | | | | | | | 4655 | |
| 33.5 | | 32.2 | | | | | | | | | | | | | | | 1415 | |
| 32.9 | | | | | | | | | | | | | | | | | 881 | |
| | | | | | | | | | | | | | | | | | 332 | 33.8 |
| 33.3 | | | | | | | | | | | | | | | | | 944 | 32.9 |
| | | | | | | | | | | | | | | | | | 1246 | 34.5 |
| | | | | | | | | | | | | | | | | | 1050 | 31.6 |
| | | | | | | | | | | | | | | | | | 1103 | 33.2 |
| 31.4 | | 33.8 | | | | | | | | | | | | | | | 1048 | 34.5 |
| | | | | | | | | | | | | | | | | | 1329 | 34.1 |
| | | | | | | | | | | | | | | | | | 1379 | 33.9 |
| | | | | | | | | | | | | | | | | | 1619 | 31.9 |
| | | | | | | | | | | | | | | | | | 1108 | 33.2 |
| | | | | | | | | | | | | | | | | | 1582 | 33.6 |
| | | | | | | | | | | | | | | | | | 702 | 33.5 |
| | | | | | | | | | | | | | | | | | 490 | 32.3 |
| | | | | | | | | | | | | | | | | | 1134 | 33.1 |
| 34.7 | | 35.1 | | | | | | | | | | | | | | | 1594 | 32.5 |
| | | | | | | | | | | | | | | | | | 1040 | 33.3 |

SERIAL TEMPERATURES OBTAINED ON LINES OF SOUNDINGS

| Date. | No. of cast. | Position. Lat. | Position. Long. | Surface-temperature. | Temperatures at depths of— Fms. 10 | Fms. 20 | Fms. 30 | Fms. 40 | Fms. 50 | Fms. 60 | Fms. 70 | Fms. 80 | Fms. 90 | Fms. 100 | Fms. 130 | Fms. 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1874. | | N. ° ′ | E. ° ′ | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° |
| July 5 | 53 | 48 01 | 151 51 | 43.2 | 41.9 | 36.6 | 33.5 | | | | | | | | | |
| | 54 | 48 21 | 155 28 | 43.9 | 39.3 | 35.9 | | | 32.7 | | | | | 32.5 | | |
| | 55 | 48 40 | 156 07 | 41.9 | 40.3 | 33.3 | 32.1 | | 32.5 | | | | | 32.2 | | |
| July 6 | 56 | 48 59 | 156 42 | 43.1 | 43.0 | 35.7 | | | 34.0 | | | | | 35.4 | | |
| | 57 | 49 23 | 157 21 | 43.2 | 42.3 | 36.2 | 31.0 | | 33.8 | | | | | 36.0 | | |
| July 7 | 58 | 49 41 | 157 58 | 42.9 | 42.1 | 36.9 | 31.0 | | 32.4 | | | | | 32.2 | | |
| | 59 | 50 02 | 158 49 | 43.7 | 41.7 | 36.3 | 31.6 | | 33.7 | | | | | 36.6 | | |
| | 60 | 50 22 | 159 40 | 42.6 | 41.0 | 33.7 | 31.5 | | 31.1 | | | | | 31.9 | | |
| July 10 | 61 | 51 06 | 161 08 | 43.8 | 42.5 | 35.2 | | | 33.6 | | | | | 36.3 | | |
| | 62 | 51 22 | 162 20 | 43.4 | 42.7 | 35.7 | | | 33.5 | | | | | 35.5 | | |
| July 11 | 63 | 51 31 | 163 23 | 42.6 | 42.1 | 35.3 | 34.8 | | 34.2 | | | 34.9 | | 34.8 | | |
| | 64 | 51 39 | 164 30 | 45.0 | | 37.0 | 34.8 | | 34.1 | | | | | 35.3 | | |
| | 65 | 51 43 | 165 25 | 46.3 | 43.8 | 40.6 | 37.3 | 35.5 | 35.0 | 34.7 | | 36.2 | | 37.6 | | |
| | 66 | 51 47 | 166 26 | 46.1 | | 40.0 | 38.0 | | 37.0 | | | 36.4 | | 37.6 | | 37.5 |
| July 12 | 67 | 51 50 | 167 22 | 45.0 | | 40.4 | 38.0 | | 37.0 | | | 36.2 | | 37.7 | | |
| | 68 | 51 52 | 168 10 | 46.4 | | 39.6 | 38.4 | | 37.2 | | | 36.9 | | 37.4 | | |
| | 69 | 51 55 | 169 00 | 47.2 | 46.5 | 42.2 | 40.9 | 39.1 | 37.8 | | | 39.2 | | 39.2 | | |
| | 70 | 51 58 | 169 42 | 47.2 | | 42.7 | 40.0 | 39.6 | 38.6 | | 38.3 | 38.4 | | 38.3 | | |
| July 13 | 71 | 52 01 | 170 28 | 46.7 | | | 41.4 | | 38.9 | | | 38.2 | | 38.8 | | |
| | 72 | 52 04 | 171 15 | 46.4 | | 42.7 | | 40.3 | | | | | | 39.1 | | |
| | 73 | 52 09 | 172 02 | 46.0 | 44.3 | 42.0 | 40.6 | 40.3 | 40.0 | | | | | 38.9 | | |
| July 14 | 74 | 52 11 | 172 41 | 46.2 | 44.7 | 42.0 | 41.3 | 40.0 | 40.5 | | | | | 39.4 | | |
| | 75 | 52 14 | 173 14 | 45.9 | 44.3 | 42.5 | 41.5 | | 39.2 | | | | | | | |
| | 76 | 52 05 | 174 01 | 45.8 | | | | 39.6 | | | | | | 38.2 | | |
| | 77 | 51 58 | 174 31 | 45.1 | 44.4 | 42.1 | | | | | | | | | | |
| | 78 | 51 50 | 175 09 | 44.9 | | | | | | | | | | | | |
| July 15 | 79 | 51 40 | 175 55 | 43.3 | | | 40.7 | | 40.2 | | | | | 39.7 | | |
| | 80 | 51 33 | 176 34 | 42.6 | | | | | 40.3 | | | | | 39.4 | | |
| | 81 | 51 30 | 177 14 | 44.7 | 44.0 | 41.6 | 40.9 | | | | | | | 39.5 | | |
| | 82 | 51 25 | 177 55 | 44.9 | | | | | | | | | | | | |
| | 83 | 51 23 | 178 19 | 43.2 | | | | | | | | | | | | |
| July 16 | 85 | 51 12 | 178 20 | 43.0 | | 40.4 | | | 39.9 | | | | | 39.2 | | |
| | 86 | 51 15 | 178 35 | 43.8 | | | | | | | | | | | | |
| | 87 | 51 10 | 178 58 | 42.6 | | | | | | | | | | | | |
| | 88 | 51 05 | 179 23 | 43.4 | | | | | | | | | | | | |
| | 91 | 51 01 | 179 14 | 46.1 | | | | | | | | | | | | |
| | 92 | 51 08 | 178 35 | 47.0 | | 41.2 | 41.9 | | 41.0 | | | | | 39.4 | | |
| | 93 | 51 15 | 178 01 | 45.9 | | | | | 40.7 | | | | | 39.2 | | |
| July 17 | 94 | 51 28 | 177 58 | 43.9 | | | | | | | | | | | | |

BETWEEN YOKOHAMA, JAPAN, AND TANAGA ISLAND, ALEUTIAN GROUP.

| TEMPERATURES AT DEPTHS OF— | | | | | | | | | | | | | | | | | BOTTOM. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fms. 200 | Fms. 250 | Fms. 300 | Fms. 350 | Fms. 400 | Fms. 450 | Fms. 500 | Fms. 600 | Fms. 700 | Fms. 800 | Fms. 900 | Fms. 1000 | Fms. 1100 | Fms. 1200 | Fms. 1300 | Fms. 1400 | Fms. 1500 | Depth, Fms. | Tem. |
| ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | | ° |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 1371 | 33.3 |
| 33.3 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 1919 | 31.3 |
| 32.6 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 2631 | 32.0 |
| . . | . . | 34.9 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 3039 | 32.9 |
| . . | . . | . . | . . | . . | . . | 35.7 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 3119 | 33.3 |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 2797 | |
| 36.6 | . . | 36.3 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 3274 | 33.1 |
| 31.2 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 3754 | |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 2970 | |
| 34.6 | . . | 34.6 | . . | . . | . . | 34.7 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 2934 | |
| 35.2 | . . | 34.3 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 2981 | |
| . . | . . | . . | . . | . . | . . | 35.2 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 2720 | |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 2793 | 33.5 |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 1896 | 33.7 |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 1777 | 34.0 |
| 37.4 | . . | . . | . . | . . | . . | . . | . . | . . | 36.0 | . . | 34.8 | . . | . . | . . | . . | . . | 2005 | 33.8 |
| 38.6 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 2320 | 34.0 |
| 38.6 | . . | 37.8 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 2711 | |
| 38.4 | . . | 37.8 | . . | . . | . . | 37.4 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 2463 | |
| . . | . . | 38.0 | . . | . . | . . | 36.9 | . . | 36.8 | . . | 36.0 | . . | 34.5 | . . | . . | . . | . . | 4037 | |
| 38.3 | . . | . . | . . | . . | . . | 37.1 | . . | . . | . . | . . | 35.4 | . . | . . | . . | . . | . . | 2463 | |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 1857 | 34.2 |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 947 | 35.9 |
| 37.2 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 1668 | 34.7 |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 332 | 37.5 |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 303 | 37.4 |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 799 | 34.4 |
| 39.2 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 998 | 35.2 |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 1014 | 35.0 |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 565 | 37.1 |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 282 | 36.7 |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 1313 | 34.3 |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 548 | 37.3 |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 237 | 39.1 |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 975 | 35.6 |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 1838 | 34.4 |
| 37.8 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 1779 | 34.3 |
| . . | . . | 38.4 | . . | . . | . . | 37.9 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 1034 | |
| . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | 233 | 39.6 |

SERIAL TEMPERATURES OBTAINED ON LINES OF SOUNDINGS

| Date. | No. of cast. | Position. | | Surface-temperature. | Temperatures at depths of— | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Lat. | Long. | | Fms. 10 | Fms. 20 | Fms. 30 | Fms. 40 | Fms. 50 | Fms. 60 | Fms. 70 | Fms. 80 | Fms. 90 | Fms. 100 | Fms. 120 | Fms. 150 |
| 1874. | | N. ° ′ | W. ° ′ | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° |
| July 25 | 100 | 52 02 | 178 07 | 48.0 | | | | | | | | | | | | |
| | 101 | 52 06 | 177 28 | 47.2 | 46.1 | 44.0 | 41.8 | 40.1 | 39.4 | | | | | | | |
| July 26 | 102 | 52 11 | 176 48 | 43.2 | | 41.2 | 41.0 | | 40.3 | | | | | 38.7 | | |
| | 103 | 52 18 | 176 01 | 47.6 | 44.0 | | 41.0 | | 40.1 | | | | | 39.0 | | |
| | 104 | 52 25 | 175 18 | 48.0 | 46.4 | 43.8 | 41.8 | 40.9 | 40.1 | | | | | 37.7 | | |
| | 105 | 52 32 | 174 27 | 47.0 | 47.2 | 42.7 | | | 39.9 | | | | | | | |
| July 27 | 106 | 52 39 | 173 51 | 48.0 | | | | | | | | | | 38.6 | | |
| | 107 | 52 47 | 173 04 | 48.2 | 46.3 | 43.1 | 41.2 | 40.5 | 39.3 | | | | | 38.7 | | |
| | 108 | 52 58 | 172 11 | 47.4 | | | | | 39.5 | | | | | 38.3 | | |
| | 109 | 53 08 | 171 19 | 46.2 | | 42.7 | | 40.2 | | 38.2 | | 37.6 | | | | |
| July 28 | 110 | 53 17 | 170 23 | 44.7 | | | 41.5 | | 38.5 | | | | | 38.3 | | |
| | 111 | 53 57 | 169 28 | 47.6 | | | | | 37.9 | | | | | 37.6 | | |
| | 112 | 53 40 | 169 01 | 48.6 | 44.4 | 42.7 | | 40.4 | 39.9 | | | | | 39.2 | | |
| | 113 | 53 57 | 168 08 | 47.9 | 43.9 | 40.7 | | | 38.8 | | | | | | | |
| July 29 | 114 | 54 06 | 168 31 | 47.9 | | | 40.1 | | 40.3 | | | | | 39.0 | | |
| | 115 | 54 13 | 167 57 | 47.4 | 44.5 | 42.5 | 41.3 | | | | | | | | | |
| | 116 | 54 11 | 167 18 | 46.6 | 43.8 | 42.5 | | | | | | | | | | |
| | 117 | 54 06 | 166 54 | 47.4 | | | | | | | | | | | | |
| Aug. 7 | 118 | 54 14 | 166 17 | 48.8 | | | | | | | | | | | | |
| | 119 | 54 23 | 165 40 | 48.9 | 44.6 | 44.0 | | | | | | | | | | |
| | 120 | 54 20 | 165 05 | 49.1 | | | | | | | | | | | | |
| Aug. 8 | 123 | 54 09 | 163 17 | 54.4 | | | | | | | | | | | | |
| | 124 | 54 10 | 162 39 | 54.2 | | | | | | | | | | | | |
| Aug. 9 | 126 | 54 08 | 161 31 | 54.2 | 46.0 | | 40.6 | | 40.3 | | | | | | | |
| | 127 | 54 05 | 160 44 | 55.2 | 53.4 | 42.9 | 40.3 | | | | | | | 40.2 | | |
| | 128 | 54 03 | 159 58 | 55.0 | 54.8 | 49.5 | 40.6 | 39.8 | | | | | | | | |
| Aug. 10 | 129 | 54 01 | 159 10 | 55.0 | 54.5 | 48.3 | 41.4 | | 39.8 | | | | | 39.4 | | |
| | 130 | 54 00 | 158 22 | 55.1 | 48.0 | 44.0 | | | 38.2 | | | | | 38.1 | | |
| | 131 | 54 00 | 157 27 | 55.0 | 54.2 | 46.4 | 42.0 | 39.2 | 38.9 | | | | | 38.9 | | |
| | 132 | 53 59 | 156 33 | 54.8 | 53.0 | 44.0 | 40.6 | | 38.6 | | | | | 38.4 | | |
| Aug. 11 | 133 | 53 54 | 155 38 | 55.0 | 54.1 | 48.7 | 40.1 | | 38.8 | | | | | 38.7 | | |
| | 134 | 53 58 | 154 44 | 55.0 | 55.0 | 51.7 | 42.1 | 40.2 | 40.2 | | | | | 39.2 | | |
| | 135 | 54 02 | 153 50 | 56.0 | 55.6 | 45.3 | 40.9 | | 38.7 | | | | | 38.8 | | |
| Aug. 12 | 136 | 54 21 | 155 07 | 56.0 | 55.9 | 46.2 | 41.3 | | 38.6 | | | | | 38.6 | | |
| Aug. 13 | 137 | 54 21 | 156 21 | 54.0 | 48.9 | 42.4 | 40.5 | | 40.0 | | | | | 39.9 | | |
| | 138 | 54 27 | 158 08 | 54.0 | 53.9 | 47.9 | 42.4 | | 39.6 | | | | | | | |
| Aug. 14 | 139 | 54 11 | 159 04 | 55.8 | 54.2 | 42.5 | 41.0 | | | | | | | | | |
| | 140 | 53 46 | 161 25 | 56.4 | 54.5 | 43.7 | 40.6 | | 39.1 | | | | | 38.6 | | |
| Aug. 15 | 141 | 53 38 | 162 31 | 56.2 | | 49.4 | 43.6 | 40.2 | 39.2 | | | | | 39.1 | | |
| | 142 | 53 33 | 163 20 | 56.6 | 55.8 | 42.6 | 40.9 | | | | | | | | | |
| | 143 | 53 30 | 164 08 | 57.1 | | 47.4 | 46.2 | | 40.9 | | | | | 39.2 | | |
| | 144 | 53 33 | 164 51 | 57.0 | 45.3 | | 43.2 | | | | | | | | | |
| | 145 | 53 40 | 165 15 | 56.2 | | | | | | | | | | | | |
| Aug. 16 | 146 | 53 57 | 165 25 | 53.9 | | | | | | | | | | | | |
| Aug. 17 | 153 | 54 05 | 163 34 | 52.8 | | | | | | | | | | | | |
| | 154 | 53 53 | 163 14 | 57.9 | | | | | | | | | | | | |
| Aug. 18 | 155 | 53 44 | 162 20 | 57.8 | 53.7 | 42.0 | 40.6 | | 40.0 | | | | | | | |
| | 156 | 53 37 | 161 32 | 57.8 | 55.5 | 48.3 | 43.9 | | 39.1 | | | | | 38.2 | | |
| Aug. 19 | 157 | 53 35 | 160 00 | 57.0 | 55.6 | 50.0 | 41.4 | | 39.2 | | | | | 39.0 | | |
| | 158 | 53 31 | 158 57 | 58.0 | 55.9 | 48.3 | 41.6 | | 39.0 | | | | | 39.1 | | |
| | 159 | 53 22 | 157 45 | 57.2 | 52.7 | 39.0 | 41.1 | 40.3 | 39.7 | | | | | 38.5 | | |
| Aug. 20 | 160 | 53 16 | 156 37 | 56.1 | 55.0 | 46.0 | 41.4 | 39.9 | 39.0 | | | | | 38.2 | | |
| | 161 | 53 06 | 155 13 | 57.1 | 55.2 | 43.4 | 40.3 | 39.4 | 39.3 | | | | | 38.6 | | |
| Aug. 21 | 162 | 52 36 | 153 39 | 58.5 | 55.6 | 46.9 | 41.8 | | 39.1 | | | | | 38.7 | | |

BETWEEN TANAGA ISLAND, ALEUTIAN GROUP, AND CAPE FLATTERY.

| Temperatures at depths of— | | | | | | | | | | | | | | | | | Bottom. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fms. 200 | Fms. 250 | Fms. 300 | Fms. 350 | Fms. 400 | Fms. 450 | Fms. 500 | Fms. 600 | Fms. 700 | Fms. 800 | Fms. 900 | Fms. 1000 | Fms. 1100 | Fms. 1200 | Fms. 1300 | Fms. 1400 | Fms. 1500 | Depth, Fms. | Tem. |
| ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | | ° |
| | | | | | | | | | | | | | | | | | 1055 | 35.1 |
| | | | | | | | | | | | | | | | | | 1339 | 34.7 |
| 38.5 | | | | | | | | | | | | | | | | | 1681 | 33.9 |
| | | 36.8 | | | | | | | | | | | | | | | 1681 | 34.6 |
| | | | | | | | | | | | | | | | | | 1755 | 34.4 |
| | | | | | | | | | | | | | | | | | 1548 | 34.0 |
| 38.3 | | | | 37.1 | | 36.9 | | | | | | | | | | | 1257 | |
| | | | | | | | | | | | | | | | | | 1029 | 35.3 |
| | | 38.2 | | | | | | | | | | | | | | | 928 | 35.5 |
| | | | | | | | | | | | | | | | | | 1006 | 35.5 |
| | | | | | | | | | | | | | | | | | 1032 | 35.1 |
| | | 37.6 | | | | 36.6 | | | | | | | | | | | 1158 | |
| | | | | | | | | | | | | | | | | | 770 | 36.1 |
| | | | | | | | | | | | | | | | | | 1169 | 35.3 |
| | | | | | | | | | | | | | | | | | 1212 | 34.1 |
| | | | | | | | | | | | | | | | | | 812 | 36.1 |
| | | | | | | | | | | | | | | | | | 959 | 35.4 |
| | | | | | | | | | | | | | | | | | 658 | 37.0 |
| | | | | | | | | | | | | | | | | | 602 | 37.2 |
| | | | | | | | | | | | | | | | | | 231 | 38.5 |
| | | | | | | | | | | | | | | | | | 89 | 41.4 |
| | | | | | | | | | | | | | | | | | 42 | 44.7 |
| | | | | | | | | | | | | | | | | | 44 | 42.5 |
| | | | | | | 38.0 | | | | | | | | | | | 500 | 38.0 |
| | | | | | | | | | | | | | | | | | 1365 | 34.9 |
| | | | | | | | | | | | | | | | | | 1500 | 33.8 |
| 39.3 | | | | | | | | | | | | | | | | | 1925 | 33.5 |
| | | 38.0 | | | | 36.6 | | | | | | | | | | | 3359 | 34.2 |
| | | 38.0 | | | | 36.9 | | 36.4 | | | | | | | | | 3130 | |
| | | | | | | | | | | | | | | | | | 2814 | 34.1 |
| | | | | | | | | | | | | | | | | | 2525 | 34.1 |
| | | 38.4 | | | | | | | | | | | | | | | 2459 | 33.7 |
| | | 38.4 | | | | | | | | | | | | | | | 2520 | 34.1 |
| | | | | | | | | | | | | | | | | | 2843 | 34.1 |
| | | 38.8 | | | | 37.2 | | | | | | | | | | | 2910 | |
| | | | | | | | | | | | | | | | | | 1148 | 35.2 |
| | | | | | | | | | | | | | | | | | 1263 | 35.0 |
| | | 38.6 | | | | | | | | | | | | | | | 2149 | 34.1 |
| | | | | | | | | | | | | | | | | | 1955 | 34.1 |
| | | | | | | | | | | | | | | | | | 1540 | 34.5 |
| | | 38.7 | | | | | | | | | | | | | | | 1555 | 34.4 |
| | | | | | | | | | | | | | | | | | 827 | 35.9 |
| | | | | | | | | | | | | | | | | | 145 | 40.6 |
| | | | | | | | | | | | | | | | | | 51 | 44.6 |
| | | | | | | | | | | | | | | | | | 55 | 41.8 |
| | | | | | | | | | | | | | | | | | 592 | 37.9 |
| | | | | | | | | | | | | | | | | | 1327 | 34.6 |
| | | 38.1 | | | | 35.7 | | | | | | | | | | | 2506 | |
| | | 38.4 | | | | 37.3 | | 36.5 | | | | | | | | | 3664 | 33.8 |
| 38.6 | | 37.9 | | 37.7 | | 37.3 | | | | | | | | | | | 2851 | |
| | | | | | | | | | | | | | | | | | 2587 | |
| | | | | | | | | | | | | | | | | | 2482 | 34.2 |
| | | | | | | | | | | | | | | | | | 2419 | 33.6 |
| | | | | | | 37.3 | | 36.4 | | | | | | | | | 2513 | |

SERIAL TEMPERATURES OBTAINED ON LINES OF SOUNDINGS

| Date. | No. of cast. | Position. | | Surface-temperature. | Temperatures at depths of— | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Lat. | Long. | | Fms. 10 | Fms. 20 | Fms. 30 | Fms. 40 | Fms. 50 | Fms. 60 | Fms. 70 | Fms. 80 | Fms. 90 | Fms. 100 | Fms. 130 | Fms. 150 |
| 1873. | | N. ° ′ | W. ° ′ | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° |
| Sept. 30 | 31 | 53 58 | 153 00 | 50.5 | 49.1 | 48.8 | 38.4 | 37.0 | 36.9 | | | | | | | |
| Sept. 29 | 32 | 53 55 | 150 01 | 50.7 | | | | | | | | | | 37.0 | | |
| Sept. 27 | 30 | 53 33 | 147 27 | 51.4 | | | | | | | | | | | | |
| | 29 | 53 27 | 146 13 | 51.0 | | | | | | | | | | | | |
| Sept. 26 | 27 | 53 02 | 143 55 | 52.2 | | | | | | | | | | | | |
| | 26 | 52 59 | 142 37 | 51.9 | | | | | | | | | | | | |
| Sept. 25 | 25 | 52 37 | 141 18 | 54.2 | | | | | | | | | | | | |
| | 24 | 52 13 | 139 55 | 53.0 | | | | | | | | | | | | |
| Sept. 24 | 22 | 51 40 | 137 32 | 53.3 | | | | | | | | | | | | |
| Sept. 22 | 20 | 51 03 | 134 41 | 55.6 | | | | | | | | | | | | |
| Sept. 21 | 18 | 50 45 | 132 39 | 56.9 | | | | | | | | | | | | |
| Sept. 20 | 16 | 50 25 | 131 03 | 57.2 | | | | | | | | | | | | |
| | 14 | 49 46 | 129 27 | 58.0 | | | | | | | | | | | | |
| Sept. 19 | 11 | 49 16 | 128 14 | 59.0 | | | | | | | | | | | | |
| Sept. 18 | 8 | 49 10 | 127 00 | 54.6 | | | | | | | | | | | | |
| Sept. 17 | 5 | 48 53 | 126 20 | 56.5 | | | | | | | | | | | | |
| | 4 | 48 47 | 126 02 | 53.2 | | | | | | | | | | | | |
| | 3 | 48 41 | 125 42 | 51.8 | | | | | | | | | | | | |
| | 2 | 48 35 | 125 25 | 50.4 | | | | | | | | | | | | |

BETWEEN TANAGA ISLAND, ALEUTIAN GROUP, AND CAPE FLATTERY.

| TEMPERATURES AT DEPTHS OF— | | | | | | | | | | | | | | | | | BOTTOM. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fms. 200 | Fms. 250 | Fms. 300 | Fms. 350 | Fms. 400 | Fms. 450 | Fms. 500 | Fms. 600 | Fms. 700 | Fms. 800 | Fms. 900 | Fms. 1000 | Fms. 1100 | Fms. 1200 | Fms. 1300 | Fms. 1400 | Fms. 1500 | Depth. Fms. | Tem. |
| ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | ° | | ° |
| 36.9 | | | | | | | | | | | | | | | | | 2534 | 32.6 |
| | | | | | | | | | | | | | | | | | 2267 | 33.1 |
| | | | | | | | | | | | | | | | | | 2299 | 32.8 |
| | | | | | | | | | | | | | | | | | 2292 | 33.1 |
| | | | | | | | | | | | | | | | | | 2158 | 33.7 |
| | | | | | | | | | | | | | | | | | 2117 | 33.9 |
| | | | | | | | | | | | | | | | | | 2074 | 34.1 |
| | | | | | | | | | | | | | | | | | 2032 | 34.0 |
| | | | | | | | | | | | | | | | | | 2031 | 34.1 |
| | | | | | | | | | | | | | | | | | 1933 | 34.2 |
| | | | | | | | | | | | | | | | | | 1626 | 34.4 |
| | | | | | | | | | | | | | | | | | 1579 | 34.4 |
| | | | | | | | | | | | | | | | | | 1007 | 35.7 |
| | | | | | | | | | | | | | | | | | 1318 | 34.8 |
| | | | | | | | | | | | | | | | | | 554 | 41.6 |
| | | | | | | | | | | | | | | | | | 88 | 43.6 |
| | | | | | | | | | | | | | | | | | 55 | 44.9 |
| | | | | | | | | | | | | | | | | | 42 | 44.4 |
| | | | | | | | | | | | | | | | | | 47 | 44.9 |

BURT'S SOUNDING NIPPER.

Fig. 3.

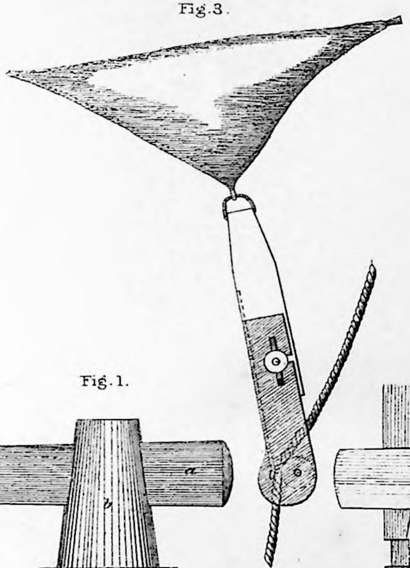


Fig. 1.

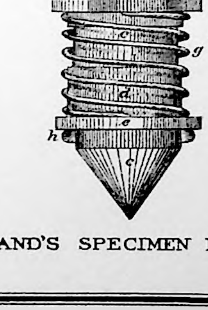
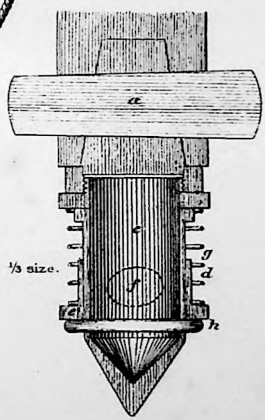


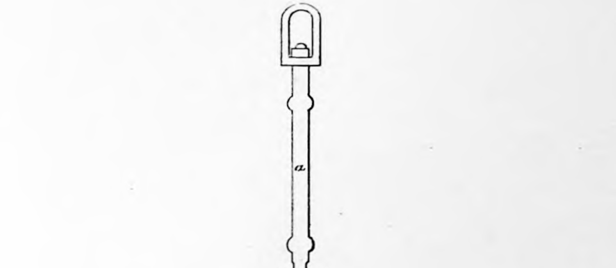
Fig. 2.



Scale for Fig. 1 & 2 ⅓ size.

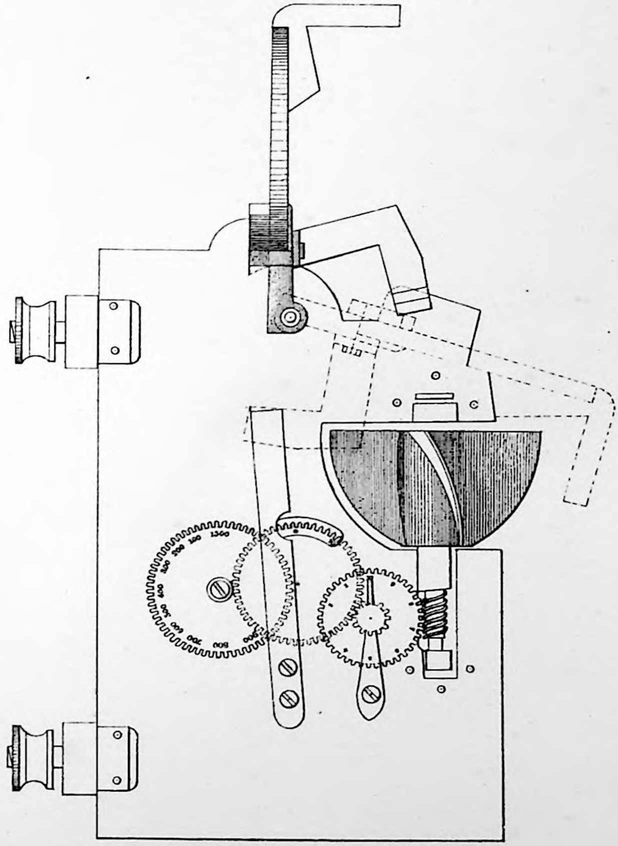
SAND'S SPECIMEN BOX FOR DEEP SEA SOUNDINGS.

SAND'S DEEP SEA SOUNDING APPARATUS.




Scale ⅜ size.

MASSEY'S SOUNDING INDICATOR
ATTACHED TO SAND'S SOUNDING APPARATUS.

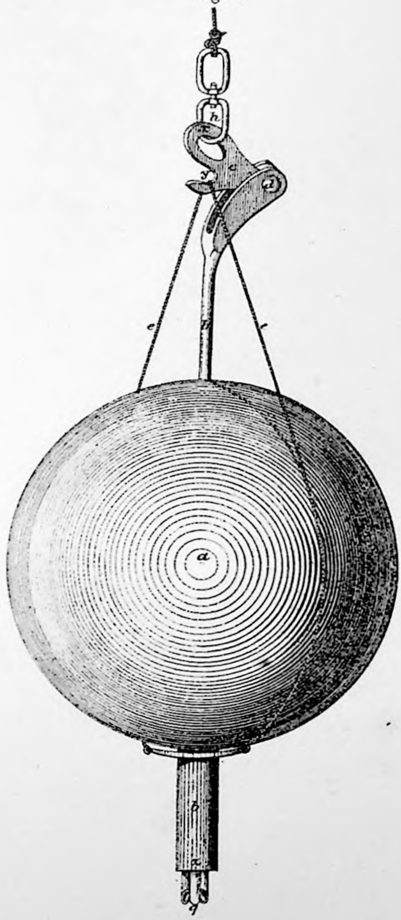


Scale ½ size.

BROOKE'S DEEP SEA SOUNDING APPARATUS

Fig. 1.

Fig. 2.



## BROOKE'S DEEP SEA SOUNDING APPARATUS.

Fig. 1.

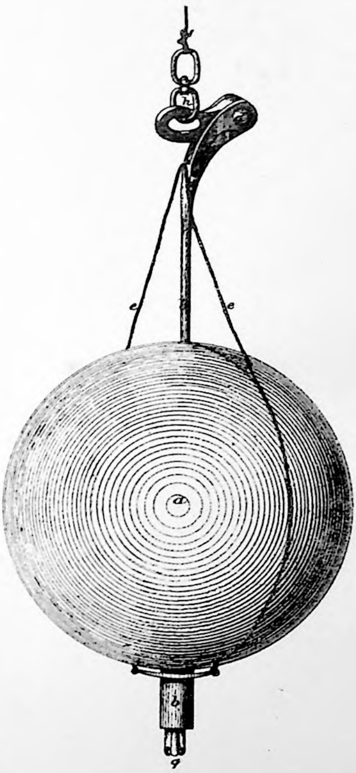
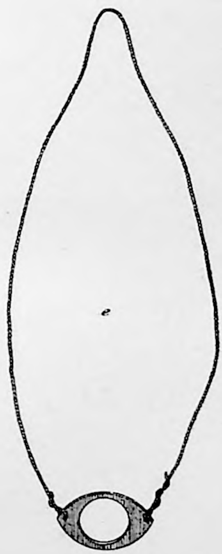
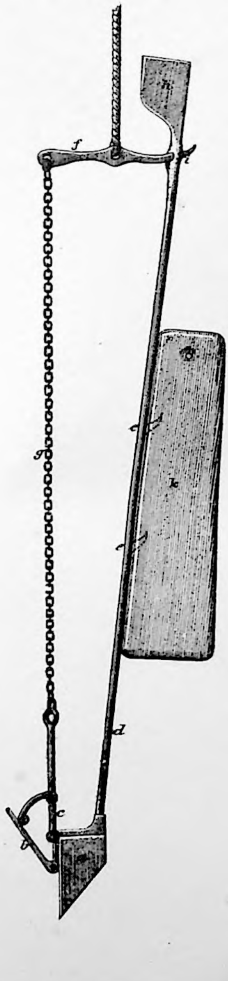


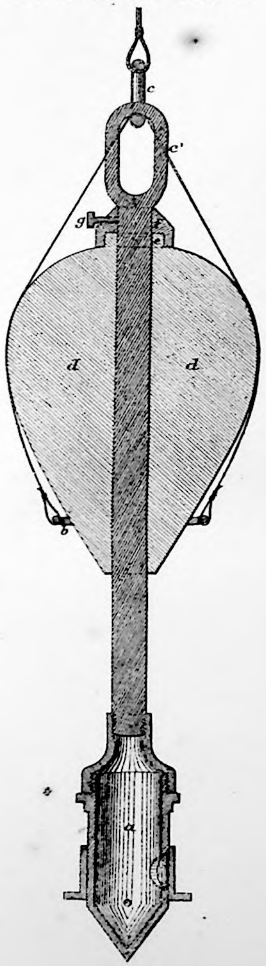

Fig. 2.



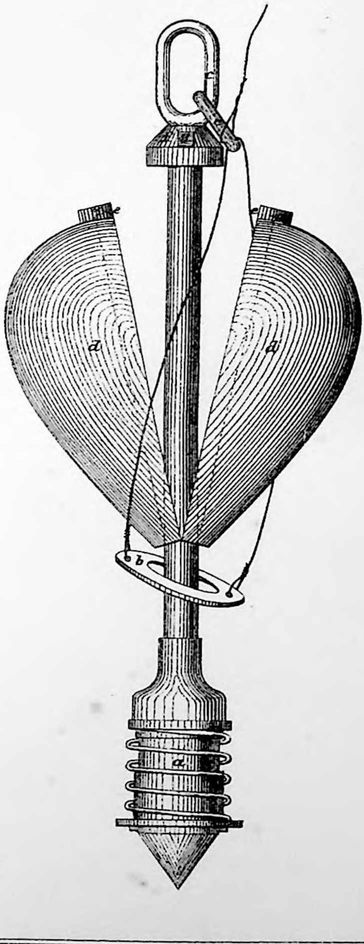
FITZGERALD SOUNDING MACHINE.



THE BROOKE-SAND'S SOUNDING APPARATUS
AS FIRST MODIFIED BY COMDR. BELKNAP.

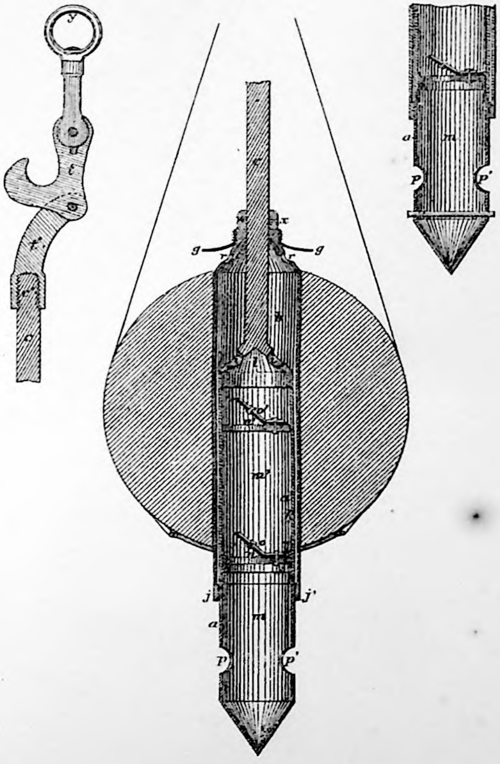


THE BROOKE-SAND'S SOUNDING APPARATUS
AS FIRST MODIFIED BY COMDR. BELKNAP.



BELKNAP DEEP SEA SOUNDING CYLINDER No. 1
WITH
BROOKE'S DETACHING ROD AND SINKER.

Fig 2. Fig. 1 Fig. 3.

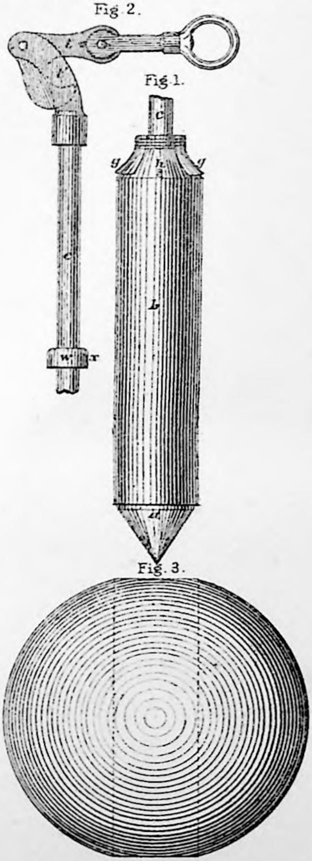


BELKNAP DEEP SEA SOUNDING CYLINDER Nº 1
WITH
BROOKE'S DETACHING ROD AND SINKER.

Fig. 2.

Fig. 1.

Fig. 3.



BELKNAP DEEP SEA SOUNDING CYLINDER No 2
WITH
BROOKE'S DETACHING ROD AND SINKER.

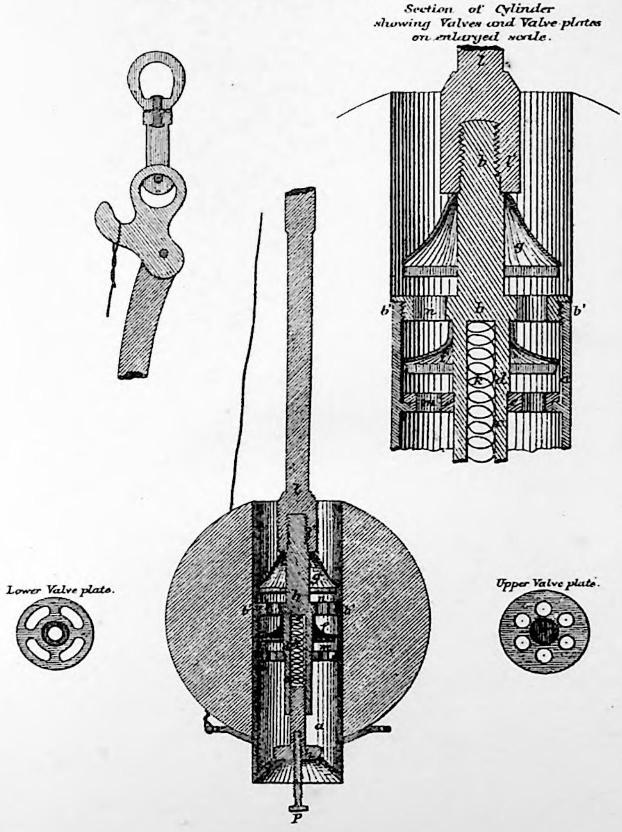
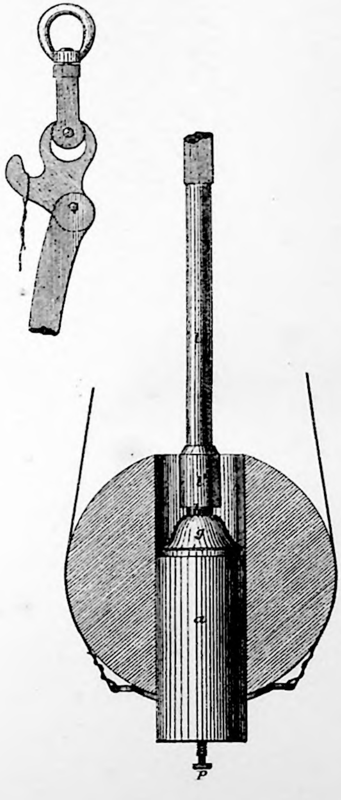
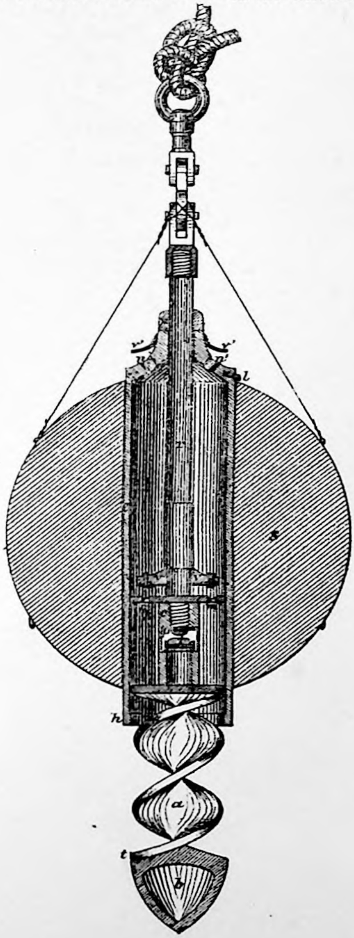


Plate XII

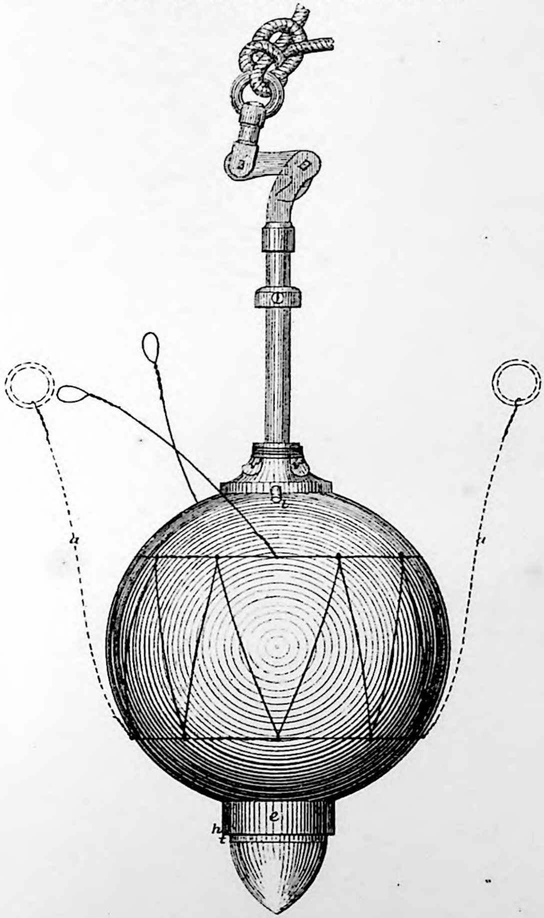
BELKNAP DEEP SEA SOUNDING CYLINDER No. 2
WITH
BROOKE'S DETACHING ROD AND SINKER.



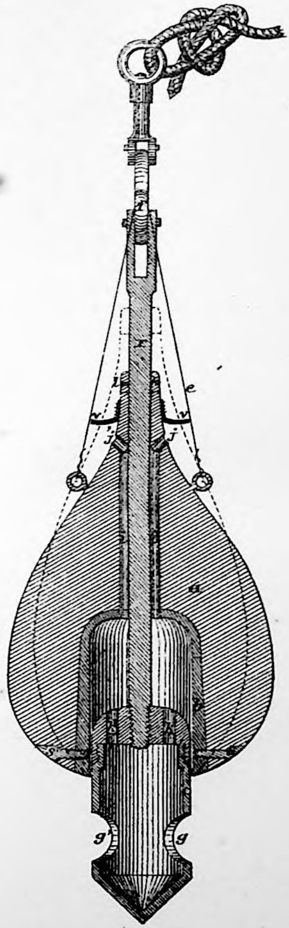
BELKNAP DEEP SEA SOUNDING CYLINDER No. 3
WITH
BROOKE'S DETACHING ROD AND SINKER.



BELKNAP DEEP SEA SOUNDING CYLINDER No. 3
WITH
BROOKE'S DETACHING ROD AND SINKER.



BELKNAP'S COASTING LEAD.



BELKNAP'S COASTING LEAD.

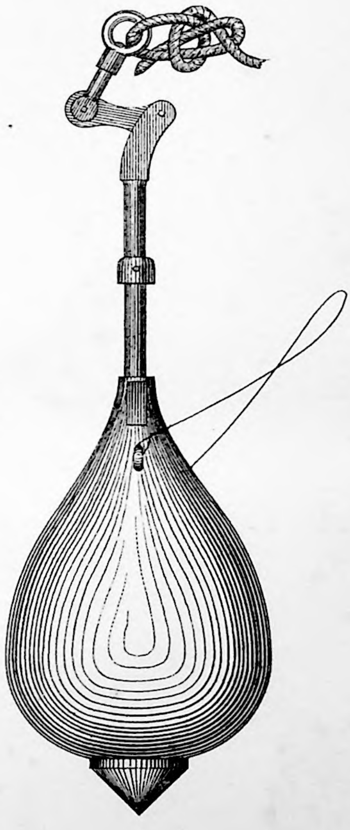


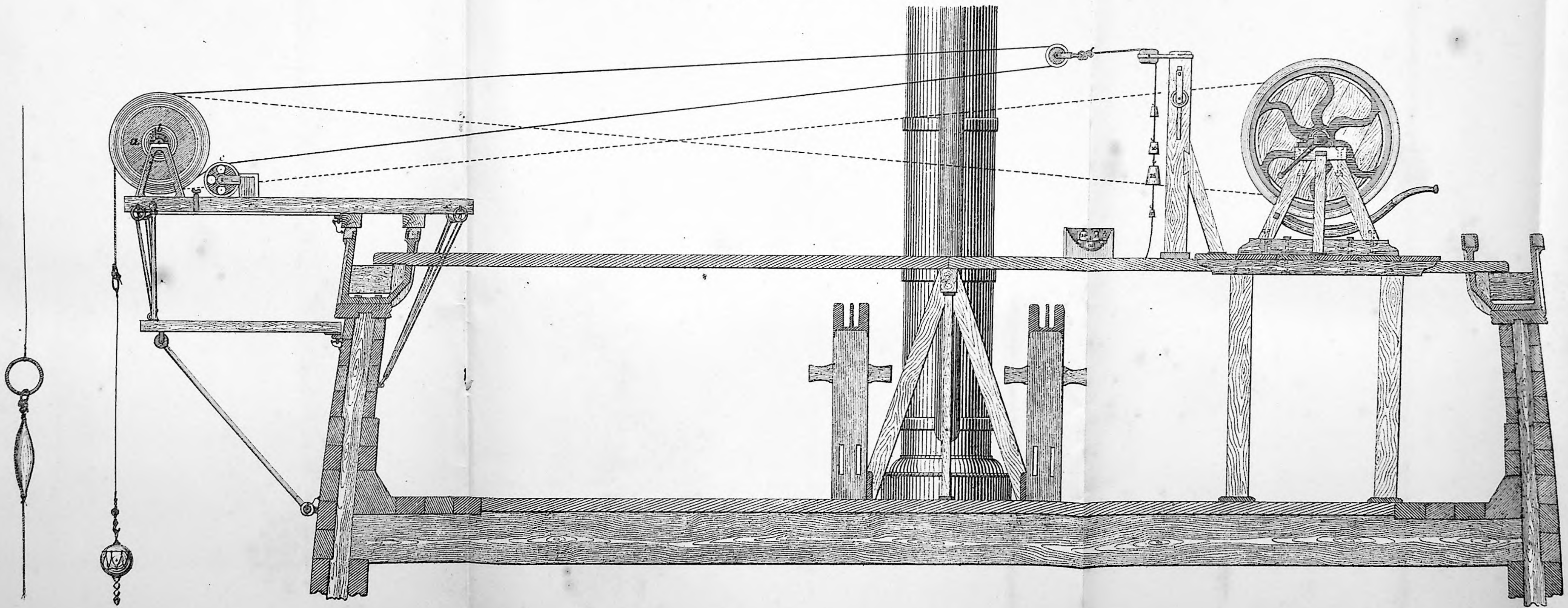
Plate XVII.

# SIDE ELEVATION

OF THE

## FLYING BRIDGE OF THE U.S.S. TUSCARORA.

Showing its position and the arrangement for reeling in, using Sir W$^{m}$ Thomson's machine and piano wire.
Note. The reeling-in apparatus constructed on board the vessel.



REELING IN APPARATUS DESIGNED AND CONSTRUCTED ON BOARD THE TUSCARORA.

Fig. 1.

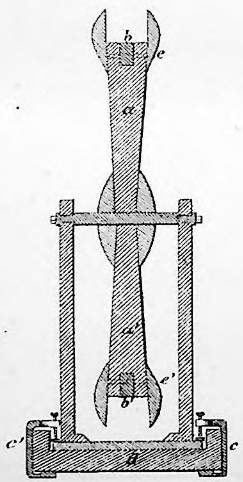



Fig. 2.

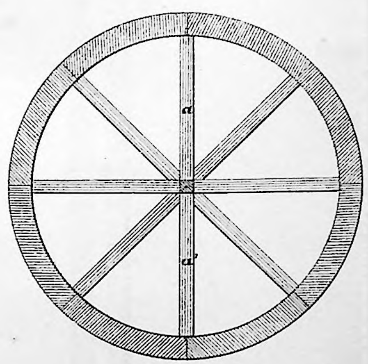



Fig. 3.

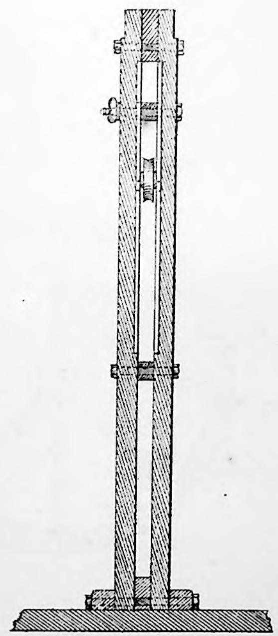
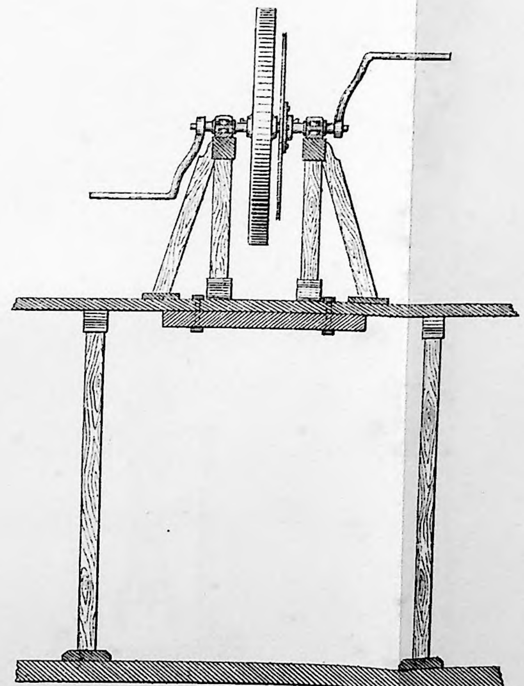
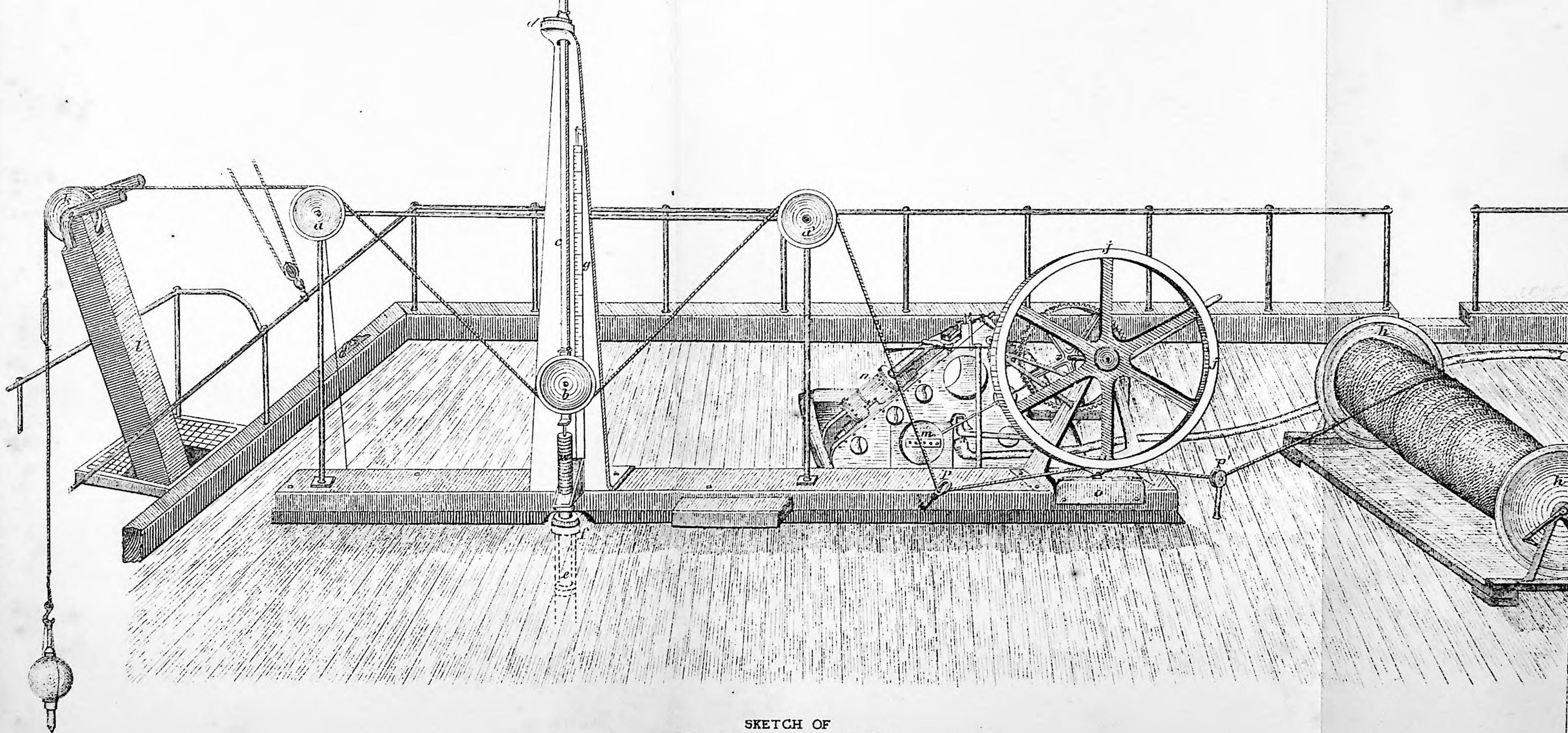


Fig. 4.



Scale 3/4 in. = 1 foot.

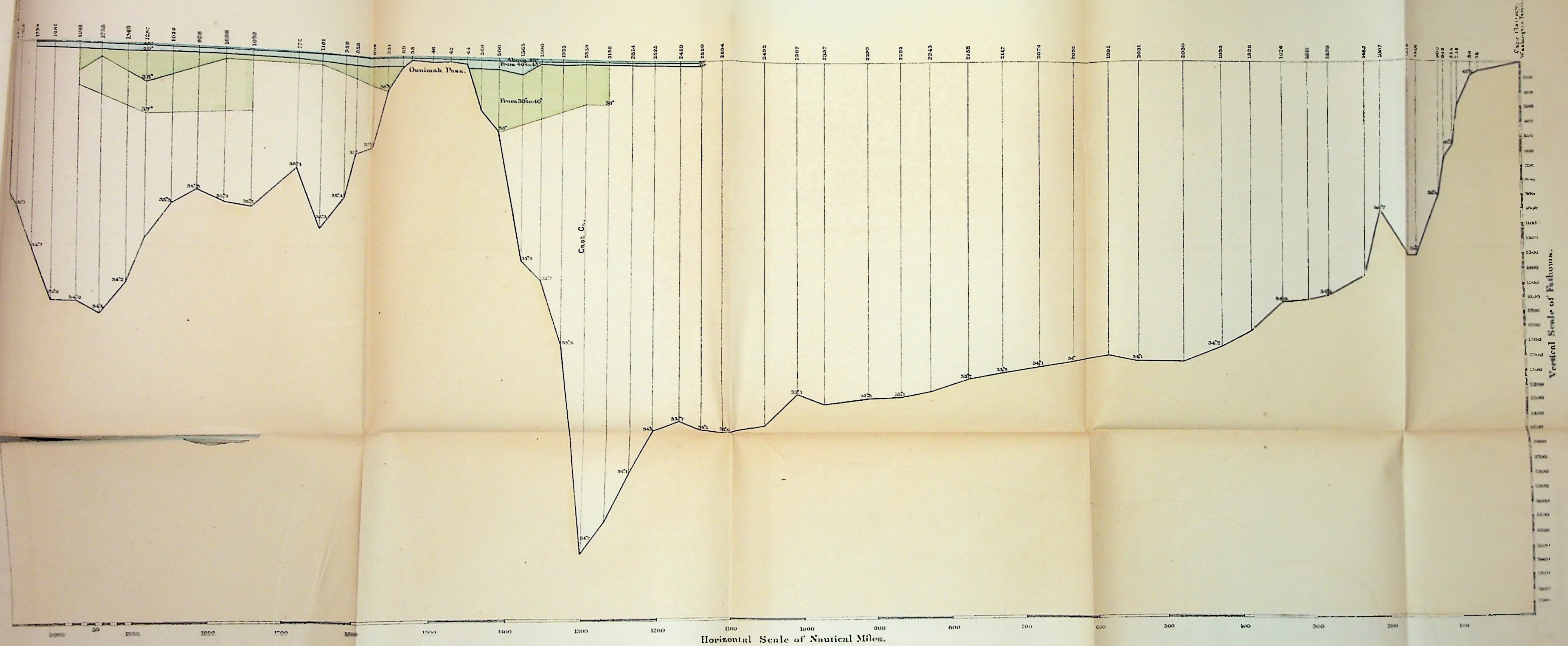



**SKETCH OF
STEAM REEL ON FORECASTLE.**

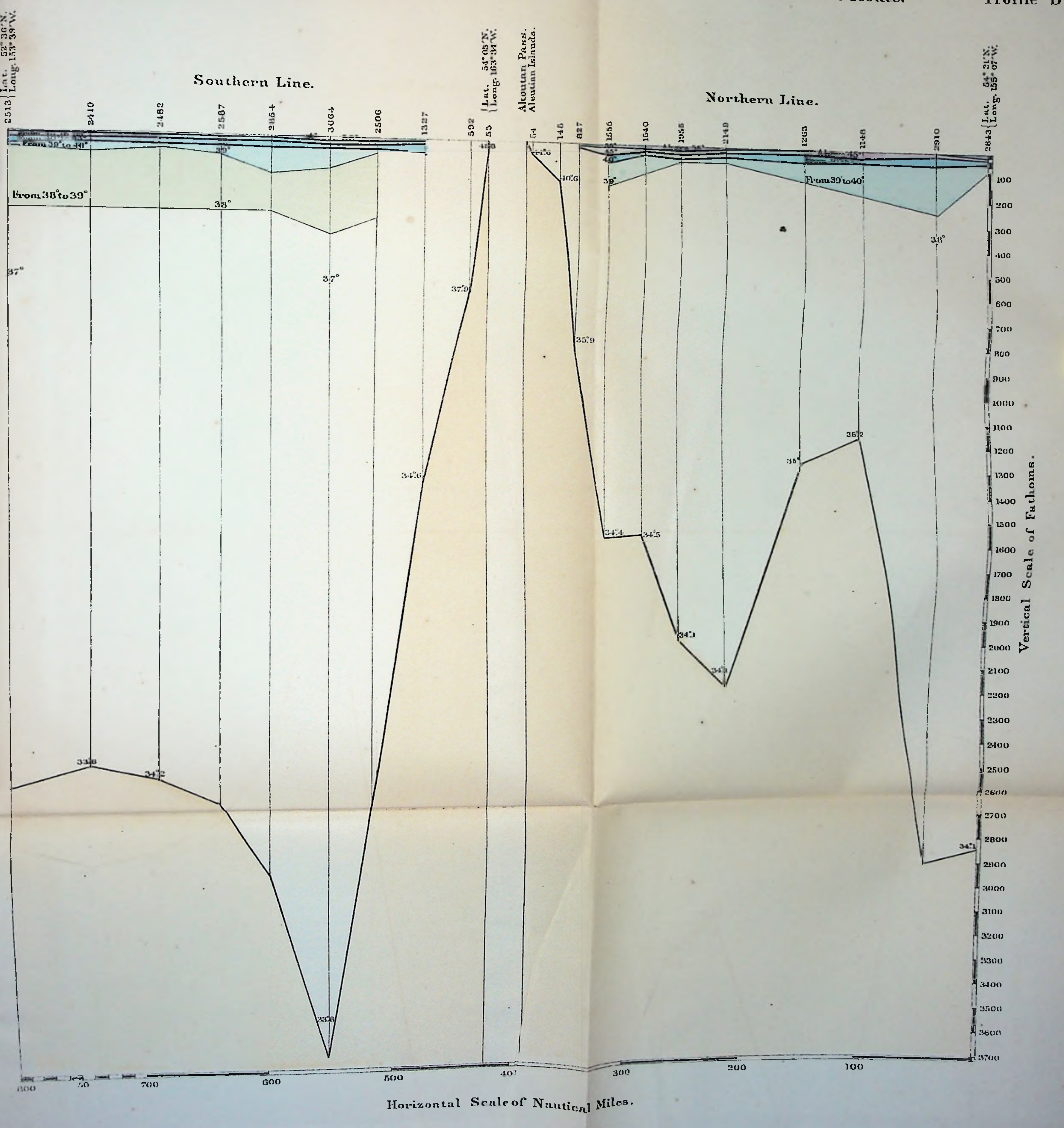
Showing position of large dynamometer with rope.

Section of Behring's Sea and the North Pacific Ocean between Tanaga Island, Aleutian Group and Cape Flattery, U.S., showing Soundings and Isothermal lines.

Profile A.

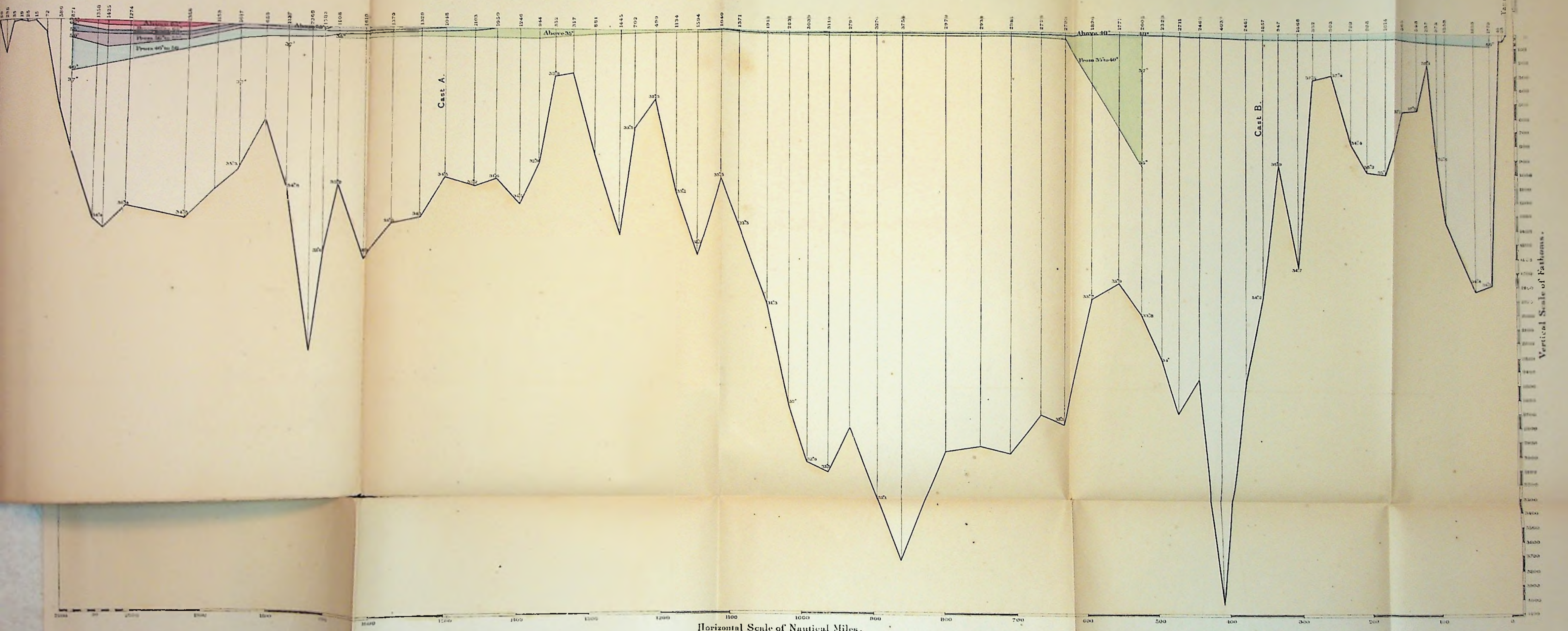


# Profiles to the Northward and Southward of Cast C on Great Circle Route. Profile B.



Section of the North Pacific Ocean between Tanaga Island, of the Aleutian Group and Yokohama, Japan, showing Soundings and Isothermal lines. Profile C.

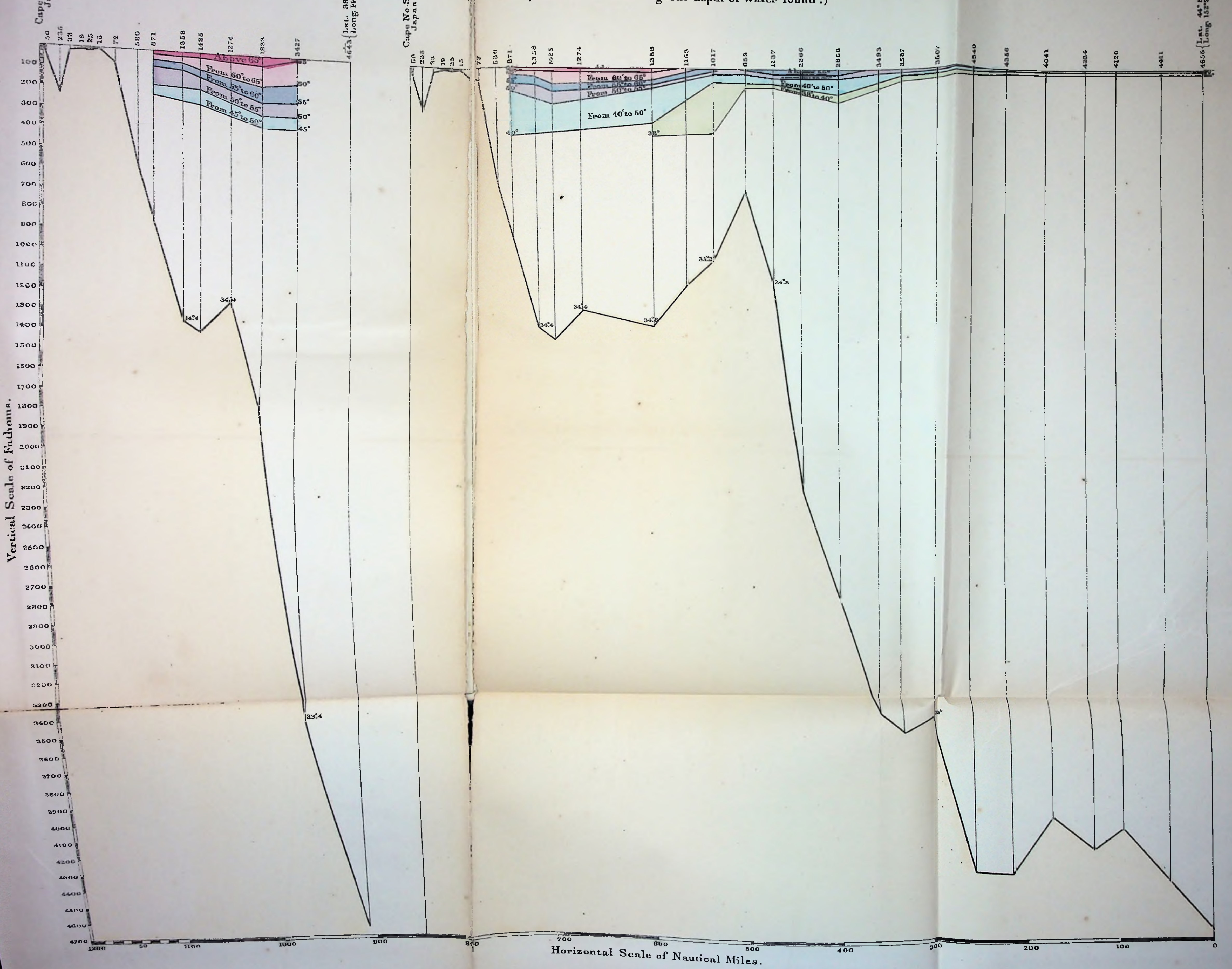
Between Casts A and B there appears to exist a stratum of cold water of about 35° at an average depth of 31 fathoms below the surface. Varying in depth from 20 to 150 fathoms, and becoming deeper as it proceeds Westward.



Profile G.

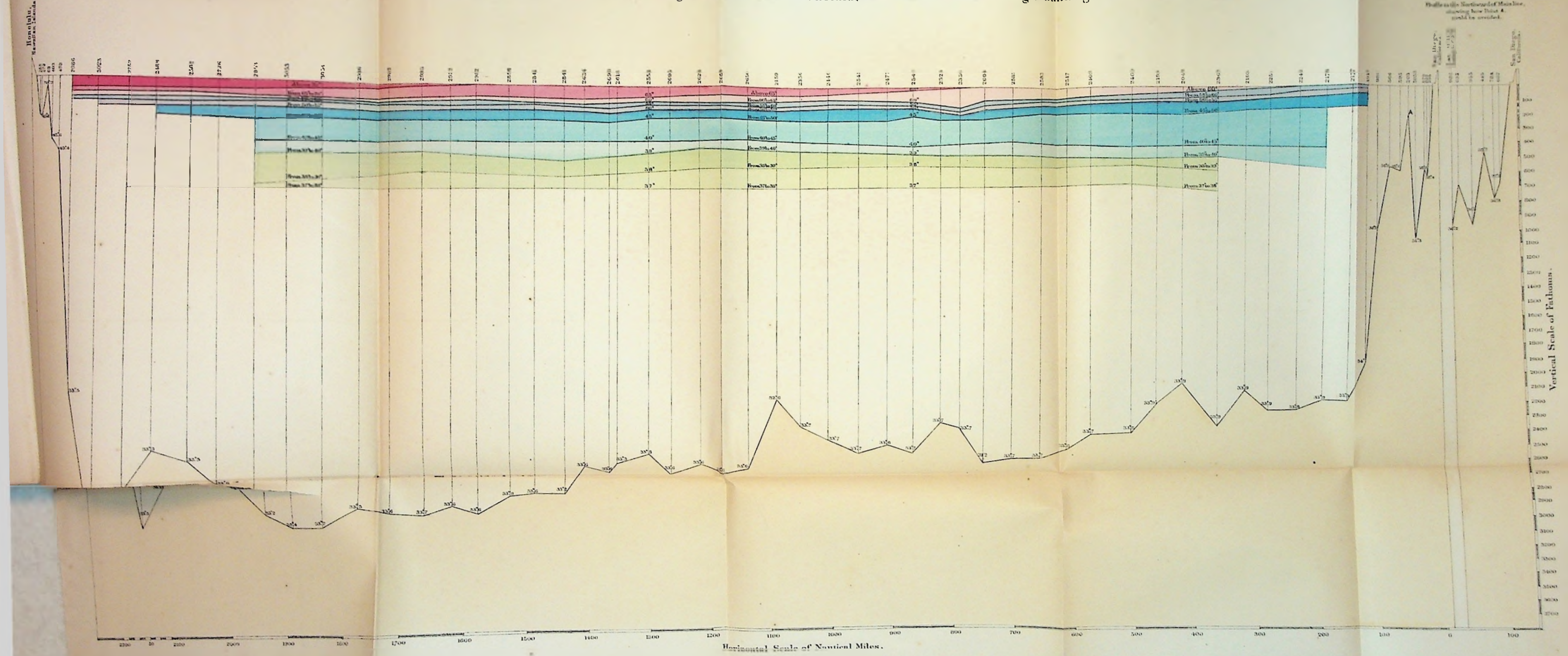
# Profiles of Lines of Soundings from Cape No-Sima, Japan, towards the Aleutian Islands, showing Soundings and Isothermal lines.

(Not completed on account of great depth of water found.)



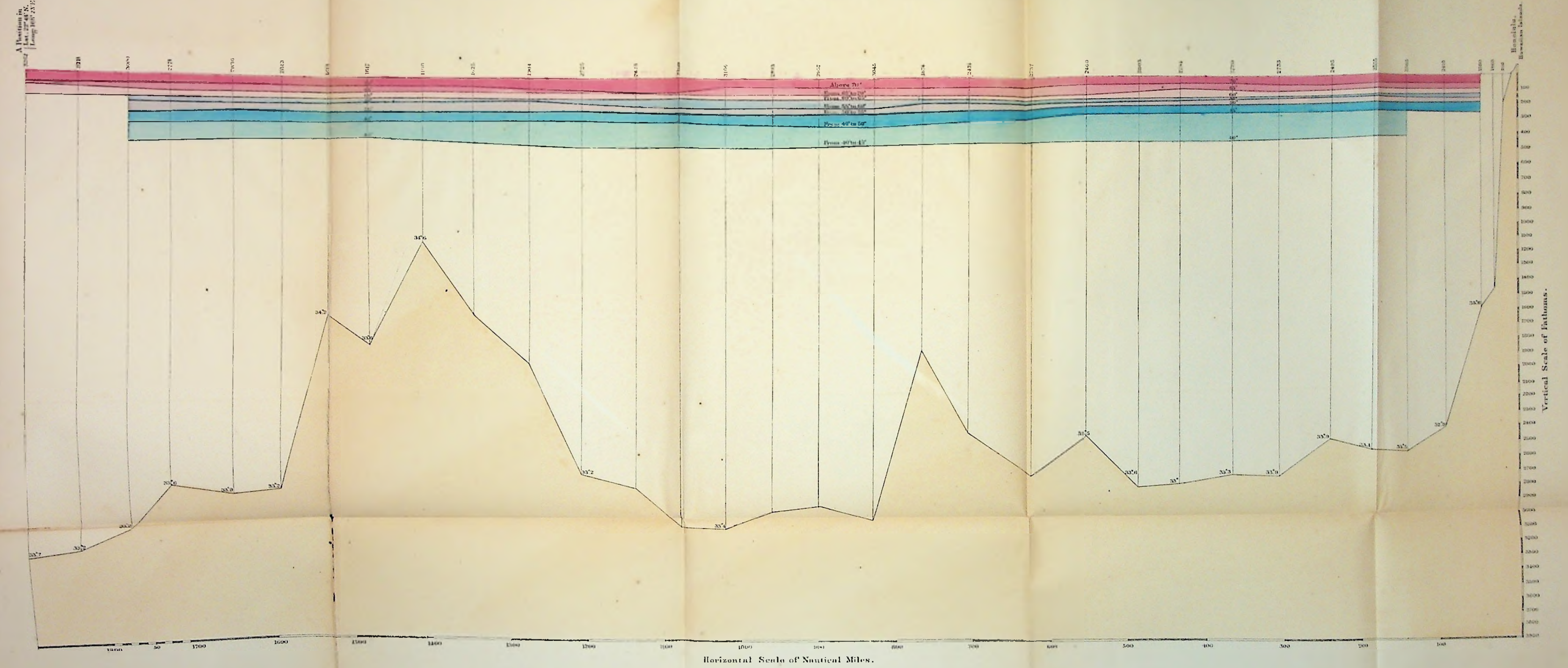
Section of the North Pacific Ocean between San Diego, California, and Honolulu, Hawaiian Islands, showing Soundings and Isothermal lines.

Profile D.



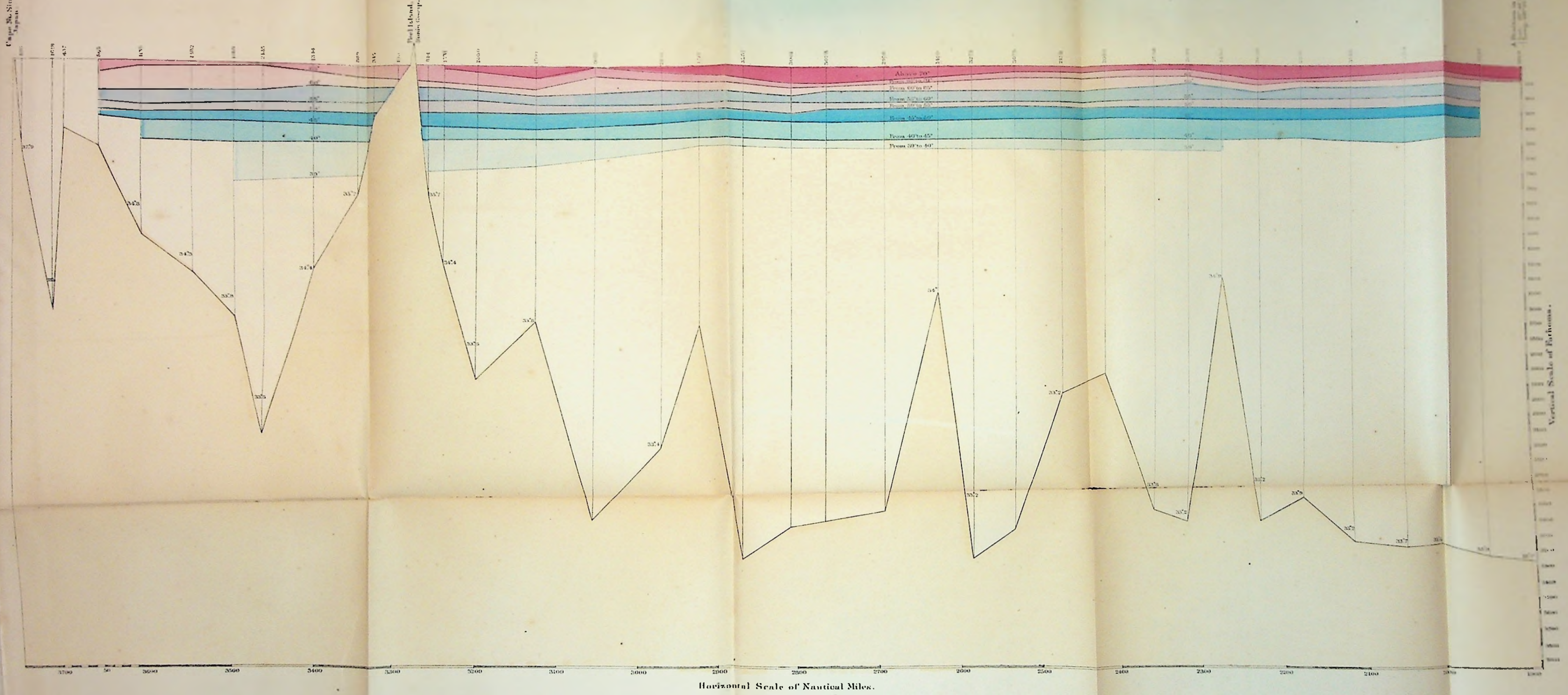
Profile E

Section of the North Pacific Ocean between Honolulu, Hawaiian Islands, & a Position in Lat. 22°44' N. & Long: 168°24' E. showing Soundings & Isothermal lines.



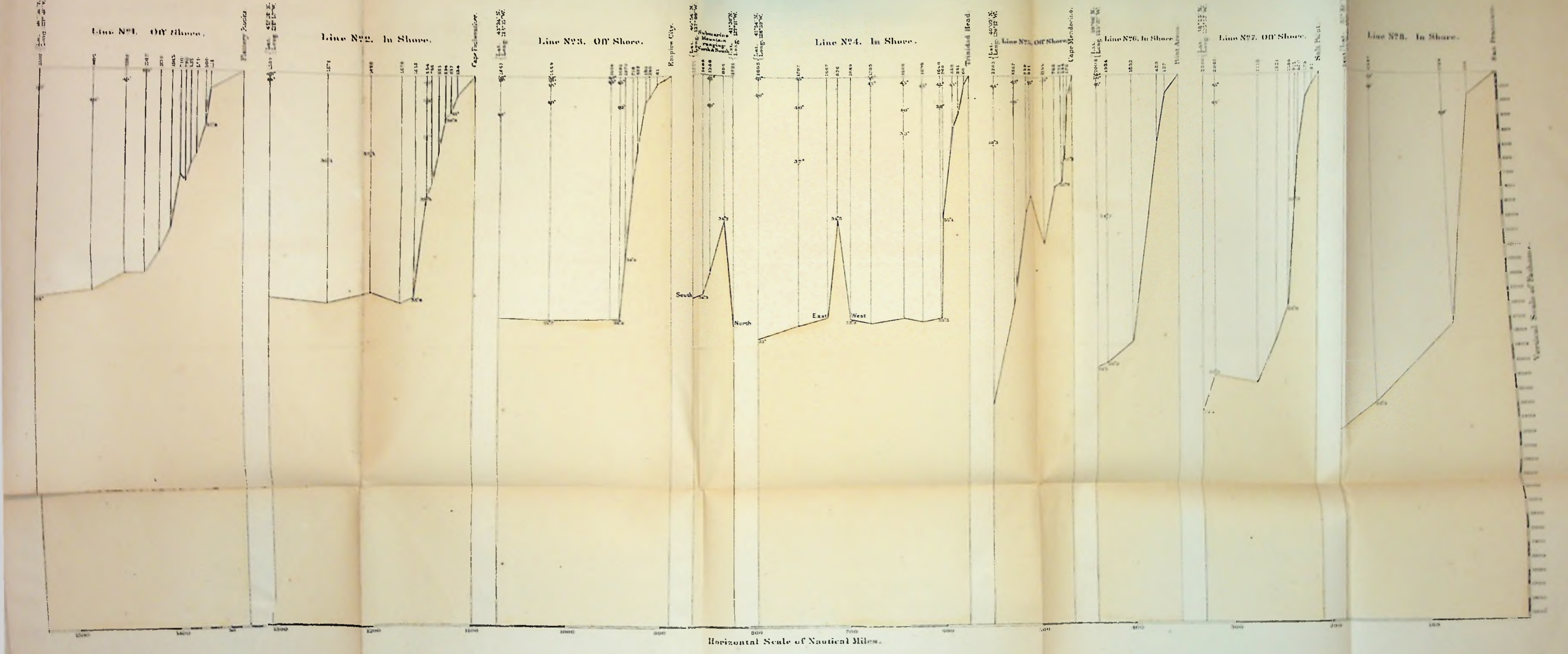
Section of the North Pacific Ocean between a Position in Lat. 22° 44' N. Long. 168° 23' E. and Peel Island, Peel Island & Cape No Sima, Japan, showing Soundings & Isothermal lines.

Profile F



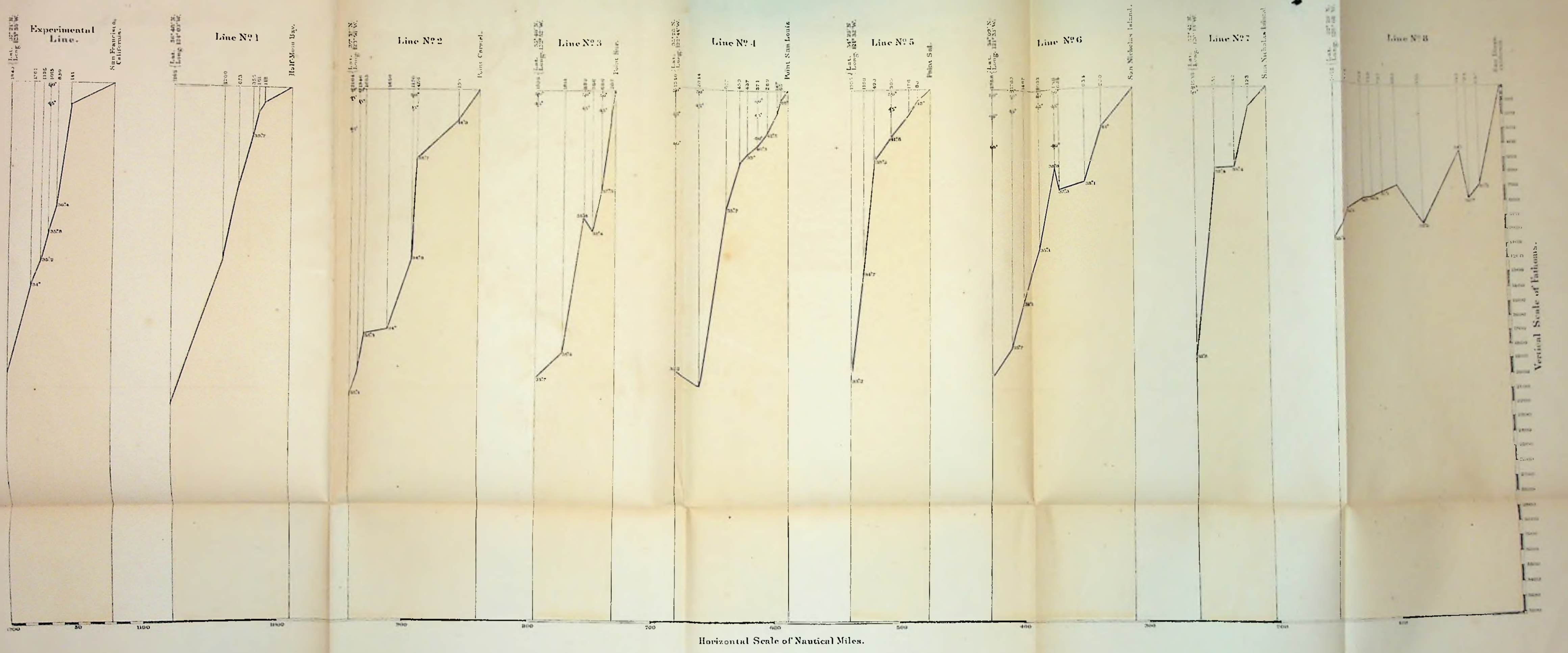
Profiles of Lines of Soundings off and on shore, from Cape Flattery, Washington Ty. to San Francisco, Cal., showing the Soundings and the Temperatures obtained.

Profile II.



Profiles of Lines of Soundings off and on shore, from San Francisco, California, to San Diego, California, showing the Soundings and the Temperatures obtained.

Profile 1.



TRACK, WIND AND CURRENT CHART
OF THE
U.S.S. TUSCARORA.
IN THE
NORTH PACIFIC OCEAN
1873-4.
Note.
BEHRING SEA
KAMTCHATKA
ALEUTIAN ISLANDS
KURIL ISLANDS
SAGHALIN
YEZO
NIPON
HAWAIIAN ISLANDS
WASHINGTON
OREGON
CALIFORNIA
SAN FRANCISCO
San Diego
Cape Flattery
BONIN ISLANDS
150° Longitude East from Greenwich
150° Longitude West from Greenwich